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ANALYSIS OF ORGANIC AIR POLLUTANTS BY GAS CHROMATOGRAPHY AND MASS SPECTROSCOPY

by

Edo D. Pellizzari
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Contract No. 68-02-2262

Project Officer

Kenneth Krost
Atmospheric Chemistry and Physics Division
Environmental Sciences Research Laboratory
Research Triangle Park, North Carolina 27711

ENVIRONMENTAL SCIENCES RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

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ABSTRACT

Analytical methodology based on capillary gas chromatography/mass spectrometry/computer was developed for the collection and analysis of urban organic pollutants. The areas of investigation included: (a) the preparation and evaluation of glass capillary columns for pollution analysis, (b) the development of methodology for quantitative analysis of ambient air pollutants, and (c) the identification and quantification of organic pollutants in ambient air from several geographical locations within the continental U.S.

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SECTION 1
INTRODUCTION

In order to ascertain whether a health-effect problem exists due to exposure to hazardous organic gases and vapors, pollutants in ambient air should be characterized and the identified chemicals quantified. In contrast to research on criteria pollutants and particulates, investigations surrounding the volatile organics has been meager. It is suspected that the major mass of organic material in ambient air is composed of organic gases and vapors. This observation is not surprising in view of the emission rates from fossil fuel consumption for energy and chemical syntheses.

Preliminary research at the Research Triangle Institute has revealed that hazardous substances in fact do occur in the ambient air. Nitrosamines and halogenated compounds have been identified, many of which are suspected mutagens and carcinogens. The major effort in the past has been associated with the characterization of halogen, oxygen, and nitrogen containing substances; however, the existence of hazardous sulfur materials are also suspected.

The main thrust of this program has been to adapt and perfect methodology[1-4] for quantitative analysis of atmospheric pollutants by gas chromatography/mass spectrometry/computer (gc-ms-comp). This report presents techniques which were developed and integrated as a total method for obtaining qualitative and quantitative information on organic vapors in ambient air. Results obtained during characterization and quantification of pollutants surrounding industrial activity are also discussed.

SECTION 8
CONCLUSIONS

The preparation and evaluation of glass capillary columns for the analysis of ambient air pollutants was performed. The four criteria of efficiency, resolution, peak symmetry and capacity were used for evaluating glass SCOT capillaries coated with OV-101, OV-17, Dexil 300 and OV-225. The four criteria indicated a superior performance could be obtained for glass capillaries over the stainless steel SCOT's. Their evaluation also indicated that complete resolution of a mixture by any one specific stationary phase for the ambient air pollutants can not be achieved on SCOT's and it was concluded that 2-3 different types of stationary phases will be necessary for analysing non-polar, semi-polar and polar ambient air pollutants.

Methods for quantitative analysis of ambient air pollutants were also examined. Determination of breakthrough volumes for various chemical classes of organic compounds on Tenax GC was studied. The chemical classes examined were acids, alcohols, aldehydes, amines, aromatics, esters, ethers, halogenated ethers and hydrocarbons, hydrocarbons, inorganic gases, ketones, nitrogen and sulfur-containing compounds. It was concluded that for highly volatile compounds, the breakthrough volumes were too small on Tenax GC and a backup sorbent was necessary. Examination of an SKC carbon indicated that the breakthrough volume for highly volatile materials could be increased by 1-2 orders of magnitude. The use of chemically bonded phases on silica indicated that the breakthrough volumes were comparable to Tenax GC and that these materials were not suitable as backups to Tenax. In the pursuit of a method for the quantification of organic vapors in ambient air, it was concluded several criteria must be addressed. In addition to the breakthrough volume, it was necessary to determine the relative molar response ratios for several organics undergoing glc/ms/comp analysis. The concept of relative molar response ratio (RMR) was delineated and the RMR's for several

compounds based on the total ion current and selected single ions (m/e) as obtained by glc/ms/comp were measured. It was concluded that the relative molar response ratios vary significantly with the type of and substitution frequency of heteroatoms in a molecule. The overall sensitivity of high resolution glc/ms/comp for the analysis of ambient air pollutants was estimated based on the breakthrough volumes and the relative molar response ratios for several organic molecules. The results indicate that parts-per-trillion to sub-parts-per-trillion sensitivity can be achieved for their detection. However, 10-50 times this amount is required for quantification.

The characterisation and quantification of ambient air pollutants in the Baltimore area revealed the presence, in addition to N-nitrosodimethylamine, of halogenated hydrocarbons. These were: 1-chloro-2-methylpropene, 3-chloro-3-methylpropene, 2,3-dichlorobutane (meso) and 2,3-dichlorobutane (one of the racemic pairs). The concentration of 1-chloro-2-methylpropene reached a level of 670,000 ng/m^3 at a location on an industrial site in Baltimore, MD. The results obtained for the characterisation and quantification of ambient air pollutants from Baltimore, MD, Kanawha Valley, WV, New Jersey and Los Angeles, CA Basin areas indicated that the technique of high resolution glc/ms/comp is a viable method of analysis. The method is capable of characterising and quantifying oxygen, sulfur and nitrogen containing compounds as well as halogenated hydrocarbons and aromatics in ambient air.

SECTION 9
RECOMMENDATIONS

Six major phases of research should be expanded and pursued: (1) a system should be developed for urban air component separation which will enable the identification and quantification of component mixtures of ambient air pollutants collected at various geographical areas; (2) qualitative identifications and quantitative estimation should be made of pollutant compositions from various environments such as the chemical industry, the products of photochemical reactions, and vehicular exhaust; (3) the sensitivity, accuracy, and reproducibility of the overall analysis systems for several classes of pollutant candidates should be further evaluated; (4) a system for quantitative analysis of atmospheric organic vapors should be developed concurrently with the qualitative identification of those components occurring in automobile exhaust samples using the techniques of gc/ms/comp; (5) organic chemical pollution profiles for the urban environments examined should be delineated into those pollutants unique to particular environment as contrasted to those pollutants commonly found as a general pollutant throughout all urban environments in order that the biological effects can be assessed, and (6) the hazardous organic vapor pollutants in atmospheres which constitutes an immediate crisis situation such as accidents occurring at industrial sites should be examined utilizing these techniques in order to access whether a health problem exists.

SECTION 4
PROGRAM OBJECTIVES

The main emphasis of this research program was to collect urban air organic pollutants for complete characterization and quantification at the parts-per-trillion level. The specific objectives were: (1) to formulate a sample collection system of sufficient efficiency to permit as a minimum the analysis of pollutants present at the low ng/m^3 concentrations; (2) to develop highly efficient glass capillary columns for the resolution of urban air pollutants with emphasis on the elution of polar and semi-polar compounds; (3) to demonstrate the overall sensitivity of the system for several classes of potential pollutant candidates and to acquire quantitative information on these substances and (4) to analyze ambient air pollutants by the use of gas chromatography in tandem with mass spectrometry and provide quantitative analysis for atmospheric organic vapors, concurrently with the qualitative identification. Studies of automobile exhaust composition which contributes to the atmospheric organic vapors were to be performed by gc/ms/comp using the techniques previously developed for ambient air pollutants. In essence, vehicle emissions from prototype vehicles were examined.

SECTION 5

PREPARATION AND EVALUATION OF GLASS CAPILLARY COLUMNS FOR POLLUTION ANALYSIS

The complexity of the pollutants in ambient air requires the use of high resolution in order to effectively separate the constituents for identification and quantification of compounds of interest.[1,2] Because these compounds are highly volatile, their analyses precludes the use of chemical purification methods since they would escape during processing. Thus, a requirement for very high resolution gas chromatography exists in order to achieve adequate resolution of these complex mixtures. The obvious approach to this problem is to utilise glass capillary columns coated with appropriate phases which will achieve adequate resolution for various chemical classes of interest. Although there are over 100 stationary phases available for gas-liquid chromatography, only a few of these effectively provide significant differences in resolution. In general it can be stated that stationary phases representative of non-polar, semi-polar and polar types will effectively produce optimum differences in the resolution patterns.

This section discusses the preparation and evaluation of glass capillary columns for the analysis of ambient air pollutants. It examines various stationary phases with regard to definitive evaluation criteria and the selection of phases which may be used for resolving, characterising and quantifying complex mixtures of ambient air pollutants.

EXPERIMENTAL

Glass support coated open tubular (SCOT) capillaries were prepared according to a previously described procedure.[3] SCOT capillaries containing the stationary phases OV-101, OV-17, Dexil 300, Poly I-110 and OV-225 were examined (Table 1).

Four criteria were used for evaluating SCOTS. These were: (1) efficiency, which was determined in terms of the height equivalent to a theoretical plate

Table 1. GLASS SCOT CAPILLARIES TESTED FOR RESOLVING AMBIENT AIR POLLUTANTS

Stationary Phase	Surfactant[a]	Percent Phase Used	Length m	i.d. (mm)
Carbowax 20M	BTPPCl/0.1%	0.90	30	0.35
OV-17	BTPPCl/0.1%	1.0	60	0.27
OV-225	BTPPCl/0.1%	1.0	104	0.27
Poly I-110	BTPPCl/0.1%	1.0	90	0.27
Quali 300 QF[1]	BTPPCl/0.1%	2.5	106	0.31

[a]Benzyltriphenyl phosphonium chloride

$$\text{HETP} = \frac{L}{5.54 \left(\frac{RT}{W_{1/2}}\right)^2}$$

L = length of column
RT = retention time (min)
$W_{1/2}$ = width of peak at half height (min)

(2) resolution, which was determined for three isomeric pairs, 4-methylpentene-1 vs 2-methylpentene-1; 1-chloro-2-methylpropene vs 3-chloro-2-methylpropene and p-xylene vs m-xylene

$$R = \frac{2 \Delta T_r}{W_1 + W_2}$$

ΔT_r = difference in retention between peaks 1 and 2
W_b = peak width at its base

(3) symmetry, which was determined for each peak as a percent ratio of the area of the front portion of the peak to the back portion. The peak was divided for this purpose by a line drawn perpendicular from the peak maxima to the baseline. Areas were measured with a planimeter.

$$\% S = \frac{f}{b} \times 100$$

f = area of front peak-half
b = area of back peak-half

and (4) capacity, which was evaluated by applying the above criteria to objections of a test mixture at three different concentrations which spanned a range of two orders of magnitude.

RESULTS AND DISCUSSION

The test mixture used for evaluating SCOT capillaries is summarized in Table 2. The components selected provided a representative range of polarities. They are compounds which have been previously identified in ambient air. Three isomeric pairs are included for comparison of the resolution obtained on the different capillary columns. These results are summarized in Table 3. None of the columns prepared and tested proved capable of completely resolving all isomers. Resolution of the olefins and chloroolefin isomeric pairs varied considerable with the polarity of the

Table 3. TEST MIXTURE FOR EVALUATING GLASS CAPILLARY COLUMNS

Compound	Relative Quantities[a] (ug/ml)
4-Methylpentene-1	1.5 (0.49)
3-Methylpentene-1	1.5 (0.50)
1-Chloro-2-methylpropene	3.0 (0.98)
3-Chloro-2-methylpropene	3.0 (0.91)
Ethyl acetate	3.0 (1.35)
2-Butanone	3.0 (1.50)
Toluene	1.0 (0.43)
N,N-Dimethylformamide	3.0 (1.42)
Tetrachloroethylene	2.0 (1.60)
p-Xylene	1.0 (0.43)
m-Xylene	1.0 (0.43)
Acetophenone	3.0 (1.54)
Nitrobenzene	3.0 (1.80)
n-Undecane	1.0 (0.37)

[a]Relative volumes used, concentration in parenthesis.

| | | |

Table 3 (cont'd)

Compound	Concentration				
4-methylpentane-1					
2-methylpentane-1					
1-chloro-2-methylpropene					
3-chloro-2-methylpropene					
ethyl acetate					
2-butanone					
toluene					
tetrachloroethylene					
N,N-dimethylformamide					
p-xylene					
m-xylene					
acetophenone					
nitrobenzene					
n-undecane					

Table 3 (cont'd)

Column	Controls													

(continued)

Table 1 (cont'd)

Run	4-acetylbiphenyl-1	2-methyl-4-acetylbiphenyl-1	3-methyl-4-acetylbiphenyl	3-ethyl-4-acetylbiphenyl	ethyl acetate	2-butanone	toluene	2-methoxyethylacetate	2,4-dimethylfluorenate	2-xylene	2-styrene	anthracene	naphthalene	2-undecane

stationary phase. None of the columns evaluated showed extremely high efficiency as measured in terms of height equivalent to a theoretical plate, however their resolution was good. Peak symmetry was near ideal on glass capillaries whereas, back tailing was clearly evident during chromatography on stainless steel capillaries.

Using the test criteria HETP, separation efficiencies, peak symmetry, and the relationship between the elution order for a standard mixture, it was possible to assess in a quantitative fashion the utility of these glass capillaries for resolving ambient air pollutants. Ideally, the selection of 2-3 glass capillaries would be preferred for the resolution of ambient air pollutants so that the identification of constituents and their quantification can be made.

SECTION 6
DEVELOPMENT OF METHODOLOGY FOR QUANTITATIVE ANALYSIS OF AMBIENT AIR POLLUTANTS

This chapter addresses a conceptual approach for obtaining quantitative information on the atmospheric pollutants which are identified in ambient air samples collected on Tenax GC. It also addresses the limitations of the sorbent Tenax GC and examines alternate sources of backup materials for collecting pollutants which are not efficiently trapped on Tenax GC.

The requirements for obtaining quantitative data with regard to the performance of the Tenax GC sorbent and the methodology for the calibration of instrumentation are described. This chapter presents studies on the various parameters which are deemed necessary for obtaining quantitative information concerning atmospheric pollutants. The subject of breakthrough volumes of various chemical classes on Tenax GC, the examination of an alternate backup sorbent and the concept of relative molar response ratios are all addressed in this chapter.

THE DETERMINATION OF BREAKTHROUGH VOLUMES FOR VARIOUS CHEMICAL CLASSES OF ORGANIC COMPOUNDS ON TENAX GC

The purpose of this study was to determine the breakthrough volumes for several organic vapors which have either been identified or are anticipated to be present in ambient air. Furthermore, the objectives were to examine several compounds within various chemical classes in order to determine whether an empirical relationship exists between a homologous series and to what extent it may be possible to predict the breakthrough volumes for compounds of similar structural types. With an empirical approach such as this, the ability to predict the breakthrough will greatly facilitate the ability to obtain quantitative information about the levels of atmospheric pollutants.

Experimental

Breakthrough volumes were estimated for a number of organic vapors which had been previously identified or anticipated to be present in ambient air [4]. The method employed consisted of determining the elution volume for an organic vapor on a gas chromatographic column packed with a sorbent Tenax GC. The column with the dimension of 2 mm x 1.76 m in length was used. After injecting each vapor, the elution volume was determined as the product of flow rate and elution time. A series of injections were made at decreasing temperatures and a plot of the log $1/V_g$ vs temperature was constructed. Using a linear regression analysis, the breakthrough volumes (50% loss) for several ambient temperatures were determined by extrapolation. At the end of the experiment, the Tenax GC sorbent in the chromatographic column was weighed and the breakthrough volume was expressed in L/2.2 g which is the standard quantity which has been employed in field sampling.

The technique for determining breakthrough volumes has been previously described and compared with other techniques which has established this method as a viable rapid approach for the determination of breakthrough volumes [1,2,4].

Results and Discussion

The breakthrough volumes of acids, alcohols, aldehydes, amines, aromatics, esters, halogenated hydrocarbons, hydrocarbons, inorganic gases, ketones, nitrosoamines, nitrogenous hydrocarbons, oxygenated hydrocarbons and sulfur compounds are given in Table 4. The breakthrough volumes for the more volatile organics such as the aldehydes (e.g. acetaldehyde) and alcohols are relatively low. Generally, the sorbent Tenax GC is not regarded to be an adequate material for the collection of these substances with any degree of reliability or sensitivity. The low molecular amines such as dimethylamine also have low breakthrough volumes.

Examination of the breakthrough volumes for aromatic compounds indicates that the incorporation of an aromatic moiety into a molecule greatly increases the affinity of Tenax GC for the organic vapor. For example, the breakthrough volume for diphenyl vs benzene is increased by almost three orders of magnitude.

Another important relationship which can be extracted from the information presented in this table is the relationship between the breakthrough

volumes at two different temperatures. The slope of the linear regressions are parallel for the compounds within a given chemical class. Therefore, if the breakthrough volume at one temperature is known, then the breakthrough at the remaining temperatures for that unknown can be calculated since the relationship is predictable.

The comparison of isobutylamine and t-butylamine breakthrough volumes reveal that although the boiling of t-butylamine is higher, it had a significantly lower retention volume on Tenax GC. In contrast, di-n-butylamine had breakthrough volumes in the m^3 range. Similar differences were observed between pyridine and aniline. It was concluded that if the compound exhibited a high degree of basicity, the retention volume would be correspondingly high. However in thoses cases where steric hindrance plays an important role in reducing the basicity of the compound (e.g. t-butylamine), then the breakthrough volume will be decreased correspondingly.

Little differences are observed in the breakthrough volume between methyl ethyl ketone and methyl vinyl ketone. Comparison of acetone and acetophenone indicates again that the incorporation of an aromatic moiety will significantly increase the breakthrough volume. This trend is also observed when comparing acetaldehyde and benzaldehyde.

The breakthrough volumes for two nitrosamines, N-nitrosodimethylamine and N-nitrosodiethylamine are also shown in Table 4. The incorporation of two methylene units into the N-nitrosodimethylamine (to yield N-nitrosodiethylamine) produces a marked increase in the breakthrough volume. In fact, it increases by a factor of 9.

Surprisingly, the inorganic gases tested exhibited rather low or no retention volume at all (NO, NO_2, Cl_2, Br_2, I_2, and SO_2) on Tenax GC. The low retention index for these inorganic gases is an important factor when considering the formation of artifacts during the concentration of organic pollutants from ambient air. For example, when high concentrations of dimethylamine occur in ambient air, the possibility of artifact formation during sampling with a cartridge sorbent such as Tenax GC via a reaction between NO_x (NO + NO_2) and dimethylamine is highly unlikely since NO_x does not accumulate. Of particular importance is also the very low breakthrough volume for water on Tenax GC; water accumulating on the substrate may

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Type of Structure	Number of Structures	Total Floor Area (Square Feet)	Average Floor Area (Square Feet)	Total Value	Average Value
Residential					
Single-family dwellings	1,000	1,500,000	1,500	$150,000,000	$150,000
Multi-family dwellings	200	400,000	2,000	60,000,000	300,000
Commercial					
Retail stores	150	300,000	2,000	45,000,000	300,000
Office buildings	50	250,000	5,000	75,000,000	1,500,000
Industrial					
Manufacturing plants	30	600,000	20,000	90,000,000	3,000,000
Warehouses	40	400,000	10,000	40,000,000	1,000,000
Public					
Schools	10	100,000	10,000	30,000,000	3,000,000
Hospitals	5	50,000	10,000	25,000,000	5,000,000
Total	1,485	3,600,000	2,424	$515,000,000	$346,801

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otherwise provide a medium for reactions such as hydrolysis of reactive species and/or formation of nitrous acid.

The breakthrough volumes for a number of sulfur containing compounds are also given in Table 4. A series of mercaptans, thiopheues and other sulfur containing compounds was studied. A direct relationship was observed between an increase in the boiling point of each compound and its breakthrough volume.

EXAMINATION OF SKC CARBON AS A BACKUP SORBENT FOR TENAX GC

The principal difficulty encountered in field use of a backup sorbent which has an affinity higher than Tenax GC has been the collection of excessive quantities of water. Unfortunately those commerical sorbents which have a higher affinity than Tenax GC for volatile organics also have a higher affinity for water. Most of the water could be eliminated by desorbing the backup cartridge with a low volume of carrier gas and trapping the vapors on Tenax. This would be similar to the back flushing techniques that are used in gas chromatography. In order for this to be an effective method of reducing the amount of water and to be a quantitative procedure for organic pollutants, it is necessary that the breakthrough volume for water be exceeded during purging without approaching the breakthrough volumes of the components of interest.

There were four requirements which were deemed necessary for a satisfactory material to be used as a backup sorbent: (1) the material must have a higher affinity for the polar organic vapors than for Tenax GC; (2) even though it may have a greater affinity for water, water must have a finite elution volume at ambient temperature, i.e. it must not be strongly retained to the sorbent so that adsorption properties for other compounds are not altered; (3) the sorbent material must allow the recovery of vapors by thermal desorption without introducing decomposition of the trapped constituents, and (4) during the thermal desorption cycle, the sorbent must not be decomposed with the formation of volatile background components or be altered such that its performance characteristics are also changed.

This section describes the examination of three silicones chemically bonded to Spherosil (100 microns) and SKC Lot No. 104 carbon. The chemically bonded stationary phases studied were an SIA075, SIB075, and SIC075 on 100-200 μ silica (Supelco, Inc., Bellefonte, PA).

Experimental

An apparatus for transferring adsorbed vapors from backup cartridges to Tenax cartridges was constructed which consisted of a cartridge holder mounted on the exhaust line of the thermal desorption unit.[2] The inlet line end of the Tenax cartridge was attached to a Beckman (8307111) 16-18 mm Teflon reducing union which was bored out to 8 mm i.d. and fitted with a Teflon insert (i.d. 2 mm) to minimise dead volume. The effluent carrier gas passed from the desorption chamber into the Tenax GC cartridge and then through a soap bubble flow meter followed by a carbon safety trap.

Results and Discussion

Preliminary experiments were conducted with Chromosorb 104 to test the transfer procedure from one cartridge to another. The Chromosorb 104 cartridges were desorbed at 280°C for 20 min and then a Tenax cartridge was desorbed further 20 min at 50 ml/min at helium purge. The Tenax GC cartridge was then removed from the line and desorbed at 270°C and analysed by gc@fid. The background eluting from Chromosorb 104 after a 20 min desorption period at 200° was excessively high so desorption was continued for 15 hrs to further condition the sorbent. Then a Tenax GC cartridge was loaded for 20 min with Chromosorb 104 cartridge at 200°C. This was repeated at 180°. Both Tenax cartridges had approximately 10 times their normal background. Chromosorb 104 could be used as a backup material for Tenax, but due to the excessive background it would be impractical for use in quantitative analysis. Accordingly, it was given no further consideration.

The first criteria evaluated for the chemically bonded silicones to Spherosil was the determination of background occurring from the sorbent during thermal desorption. Sorbents were loaded into cartridges (1.5 x 6 cm bed) and desorbed in a 50 ml/min helium stream for 30 min. The chemically bonded Spherosil were desorbed at 150° and the carbon at 370°. At the end of the desorption period, the background was determined by either cryogenic trapping of the effluent stream (-196°C) or 10 min or trapping vapors from the effluent stream with a 1.5 x 6 cm bed of Tenax for 10 min. Desorption was continued for a period of upto 110 min and the effluent was tested at 20, 40 and 90 min. The background for the chemically bonded phases on the Spherosil was comparable to that of Tenax GC. On the otherhand, the

background from SKC carbon which was much smaller, an initial desorption time of approximately 30 min was necessary to minimise background.

Preliminary test of collection efficiency for silicone chemically bonded to Spherosil was also run by sampling lab air with a Tenax GC cartridge in tandem with a Spherosil cartridge. The Spherosil cartridge was then thermally desorbed and analysed. The results were compared with those from a Tenax backup cartridge which had been loaded with laboratory air simultaneously under the same sampling conditions. The quantities of vapors collected by the Spherosil backup cartridges were substantially smaller than those collected on the Tenax backup cartridge. From this it concluded that the affinity of organic vapors for the chemically bonded Spherosil tested was substantially smaller than their affinity for Tenax GC. Thus, they would not be suitable backup sorbents for Tenax and no further consideration was given to them.

Experiments were conducted to examine the recovery of vinyl chloride from SKC carbon and the possibility of transferring desorbed volatile organic vapors from carbon to Tenax GC cartridges. One of the problems associated with the use of carbon cartridges for sampling has already been mentioned earlier, i.e. the accumulation of significant amounts of water. In order to transfer the volatile organic vapors from the carbon cartridge to the analytical system, the water which is desorbed must be eliminated. It has been our experience that the direct interfacing of the SKC carbon cartridge to the analytical system produces icing and plugging of the capillary trap on the inlet manifold which is used to concentrate and transfer the organic vapors to the SCOT capillary column.

Vinyl chloride standards were prepared from a standard source of concentration of 10 ppm. A standard amount (250 ng) was loaded onto a cartridge and experiments in which the desorption of the vinyl chloride from SKC carbon was directly introduced into the analytical system. The desorption unit was operated at 290°C with the helium purge range of 30 ml/min. The desorbed vapors were trapped in a 0.5 ml i.d. x 0.5 m length, trans-axial Ni capillary trap cooled with liquid nitrogen. Vinyl chloride vapors desorbed and analysed in this manner were compared to the response of an equivalent amount loaded onto Tenax GC cartridges (1.5 x 6 cm).

Analysis were performed on a Perkin-Elmer 900 gas-liquid chromatograph equipped with a 400 ft OV-101 stainless steel SCOT capillary programmed from 30-240°C at 4°/min with a 4 min delay. The carrier gas flow was 4 ml/min. The response obtained for the peak corresponding to vinyl chloride desorbed from Tenax was taken as a reference response (250 ng).

A 1.5 cm i.d. x 4 cm bed of SKC carbon was loaded on one end with vinyl chloride and placed into the thermal desorption unit so that it was "down". The desorption of the cartridge and analysis indicated a response that was 95% of the standard response. When the vinyl chloride vapor was loaded in the middle of the cartridge with a hypodermic syringe, the response was 40% of the standard. In the third case, the vinyl chloride was loaded at one end of the carbon cartridge and introduced in the unit so that this end was "up". In this case the response was 40% of the standard. The desorption time in each case was 10 min.

The desorption of vinyl chloride from carbon onto a 6 cm Tenax GC cartridge was evaluated. Vinyl chloride was loaded onto carbon and the carbon cartridge desorbed at 290° for 6 min onto Tenax at a 30 ml/min He purge rate. The response of the detector obtained for the desorption of the Tenax GC cartridge was 40% of the vinyl chloride standard.

When a carbon cartridge which has been utilised in field sampling was desorbed for 10 min onto a Tenax cartridge, a considerable amount of water condensed on a glass wool plug which held the Tenax GC bed. During the desorption of the Tenax GC cartridge, the Ni capillary trap froze and the purged gas flow dropped to zero. Thus it was decided that a desiccant was needed in order to remove the water vapor.

A Tenax GC cartridge was then loaded with vinyl chloride and desorbed for 5 min onto another Tenax cartridge and when the backup Tenax cartridge was analysed, the vinyl chloride response was 95% of the standard. This experiment was repeated using a 1.5 cm x 1 cm length of calcium sulfate bed placed in-line prior to the backup Tenax GC cartridge. The backup cartridge was then analysed and the response was 40% of the standard. The Tenax GC cartridge was then loaded with vinyl chloride and desorbed for 15 min through the calcium sulphate plug and onto a backup Tenax GC cartridge. The response obtained in this case was 90% of the standard. It was concluded that an additional purged

volume through the calcium sulphate was necessary in order to exceed the breakthrough volume for vinyl chloride.

A carbon cartridge which had been used in field sampling was desorbed and purged for 15 min through the calcium sulphate drying tube and onto a Tenax cartridge. Calcium sulphate effectively reduced the amount of water vapor so that the capillary trap on the thermal desorption unit did not freeze when the Tenax cartridge was desorbed.

Using a smaller cartridge packed with SKC Lot No. 104 carbon (0.5 cm x 4 cm in length), the collection and recovery by thermal desorption utilizing the calcium sulphate drying tube and the desorption of the backup Tenax cartridge yielded a 95% or better recovery of vinyl chloride.

Since the above experiments indicated that it was feasible to desorb vinyl chloride from SKC carbon Lot 104 and transfer it to Tenax cartridges for further analysis, we then investigated the breakthrough volumes of vinyl chloride, vinyl bromide, methyl chloride and methyl bromide on this SKC charcoal. The method for estimating the breakthrough volumes has been previously described.[1,2,4] Tables 5 and 6 present the breakthrough volumes for vinyl chloride, vinyl bromide, methyl chloride and methyl bromide on this SKC charcoal (104). For vinyl chloride the breakthrough volume increased from 0.9 ℓ/g for Tenax to 104 ℓ/g of SKC charcoal (50°F in both cases). Thus the increase in the retention volume for the vinyl chloride was approximately 2 orders of magnitude greater than that of Tenax GC. Similar results were observed with vinyl bromide whereby breakthrough volume on Tenax GC increased from 3.6 ℓ/g to 386 ℓ/g of SKC charcoal (also 50°F). Again, the increase in the breakthrough volume was approximately 2 orders of magnitude. Comparison of the breakthrough volumes between Tenax and SKC charcoal for methyl chloride and methyl bromide indicated a significant increase in the breakthrough volume when using charcoal. These results indicate that the SKC carbon provides an adequate sorbent material for the collection of vinyl chloride, vinyl bromide, methyl chloride and methyl bromide with significantly higher breakthrough volumes which will allow more sensitive analysis and possibly quantification of these compounds in ambient air.

Based on the results of the breakthrough volumes of compounds on Tenax GC and SKC charcoal Lot No. 104, it was concluded that the SKC charcoal could serve as a backup to Tenax GC for those sampling strategies requiring the

Table 5. ESTIMATION OF BREAKTHROUGH VOLUMES FOR VINYL CHLORIDE AND VINYL BROMIDE ON SKC CHARCOAL (104)

Temperature °C (°F)	Vinyl Chloride		Vinyl Bromide	
	L/g	L/2.53 g[a]	L/g	L/2.53 g[a]
10 (50)	104	262	388	978
15.5 (60)	81	204	306	771
21.1 (70)	63	159	241	608
26.7 (80)	49	123	190	479
32.2 (90)	38	96	150	378
37.8 (100)	30	76	118	298

[a]A 1.5 cm i.d. x 4.0 cm bed of charcoal weighs 2.53 g.

Table 6. ESTIMATION OF BREAKTHROUGH VOLUMES FOR METHYL CHLORIDE AND METHYL BROMIDE ON SKC CHARCOAL (104)

Temperature °C (°F)	Methyl Chloride		Methyl Bromide	
	L/g	L/2.53 g	L/g	L/2.53 g
10 (50)	14.3	36	98	248
15.5 (60)	11.1	28	75	190
21.1 (70)	8.7	22	57	143
26.7 (80)	7.5	19	43	108
32.2 (90)	5.6	14	32	82
37.8 (100)	4.4	11	25	62

collection and analysis of the more volatile compounds in ambient air. The feasibility of thermally desorbing and transferring to Tenax GC cartridges to eliminate the presence of high concentrations of water on the SKC charcoal cartridges was demonstrated in these experiments.

ESTIMATION OF RELATIVE MOLAR RESPONSE RATIOS FOR SEVERAL ORGANIC VAPORS

In the pursuit of a method for the quantification of organic vapors in the ambient air, several criteria must be addressed. The first is the determination of breakthrough volume on the sorbent material which is being utilized to trap the organic vapors from the ambient air. Secondly, the process of transferring the organic vapors trapped on the sorbent to the analytical system must be standardized in order to insure that quantitative recoveries are obtained. Another aspect which must be addressed is instrument calibration for determining the absolute quantity of each pollutant originally on the sampling cartridge. The utilization of a standard curve for all compounds to be quantified in ambient air is not feasible. One approach which can be used to circumvent the preparation of standard curves is the use of relative molar response ratios. Successful use of this method requires information on the exact amount of standard added and the relationship of RMR (unknown) to the RMR (standard).[5]

The use of the RMR method for quantifying ambient air pollutants is described here.

Experimental Method

The method of calculation for RMR is as follows:

$$(1)\quad RMR_{unknown/standard} = \frac{A_{unk}/Moles_{unk}}{A_{std}/Moles_{std}}$$

A = peak area, determined by integration or triangulation.

The value of RMR is determined from at least five independent analyses.

$$(2)\quad RMR_{unk/std} = \frac{A_{unk}/g_{unk}/GMW_{unk}}{A_{std}/g_{std}/GMW_{std}}$$

A = peak area, as above
g = number of grams present
GMW = gram molecular weight

Thus, in the sample analyzed:

$$(3)\quad g_{unk} = \frac{A_{unk} \cdot GMW_{unk} \cdot g_{std}}{A_{std} \cdot GMW_{std} \cdot RMR_{unk/std}}$$

The standard may be added as an internal standard during sampling. However, since the volume of air taken to produce a given sample is accurately known, it is more practical to use the external standard method whereby the standard is added to the cartridge after the sample has been collected in the field. Two external standards were selected. These were hexafluorobenzene and perfluorotoluene. The retention index for these external standards is such that the elution from the glass capillary column (OV-101) occurs at a temperature and time which does not interfere with the analysis of unknown compounds in ambient air samples.

Results and Discussion

Since the volume of air taken to produce a given sample is accurately known and an external standard was utilized, then grams (unknown)/volume (air) can be determined. In order to successfully utilize this technique, the RMR's for organic vapors must be determined either with authentic compounds which were identified in the ambient air or with their analogs.

The relative molar response factors for several compounds based upon the total ion current monitor of the GC/MD/COMP system is shown in Table 7. The RMR's were calculated using the two external standards, perfluorobenzene (PFB) and perfluorotoluene (PFT). The statistical variances and deviation are also indicated. As might be expected, the RMR values for aromatic hydrocarbons are quite similar to one another. Thus by choosing the appropriate RMR in a homologous series it can be utilized for calculating concentrations of constituents where the authentic compound is unavailable and its RMR is not known.

The RMR factors for hydrocarbons also reveal a very close similarity in a homologous series. The greatest variation occurs with the halogenated hydrocarbons. They may vary several fold.

The relative molar response values for several compounds based on selected ions are given in Table 8. In this case, a unique ion which is characteristic of that compound was selected and a relative molar response factor calculated relative to one of the ions selected for hexafluorobenzene (m/e 186). A second ion for each compound was also utilized for calculating

Table 7. [illegible] FOR SEVERAL COMPOUNDS BASED UPON TOTAL ION CURRENT VERSUS

Chemical Class	Compound	[illegible][a]			[illegible][a]		
		[illegible]	Var.[b]	S.D.[c]	[illegible]	Var.	S.D.
Aromatic hydrocarbons							
	Toluene	2.38	0.038	0.13	2.48	0.110	0.33
	p-Xylene	2.98	0.179	0.42	2.33	0.200	0.45
	Cumene	1.56	0.050	0.22	1.76	0.026	0.16
	1,3,5-Trimethylbenzene	1.48	0.050	0.22	1.63	0.057	0.19
	1,2,4-Trimethylbenzene	1.47	0.025	0.16	1.67	0.006	0.08
	1,2,3-Trimethylbenzene	1.26	0.040	0.19	1.45	0.023	0.11
	Phenylacetylene	1.25	0.002	0.05	1.45	0.010	0.12
	Naphthalene	1.34	–	–	1.53	–	–
	α-Methylstyrene	1.88	0.002	0.05	2.04	0.004	0.06
	Indan	1.54	0.024	0.16	1.76	0.027	0.16
	Tetrahydronaphthalene	1.58	–	–	1.72	–	–
Oxygenated aromatic							
	Anisole	1.77	0.290	0.54	2.14	0.040	0.20
	Acetophenone	0.58	0.040	0.20	0.79	0.007	0.08
	Styrene oxide	0.35	0.030	0.16	0.35	0.020	0.14
	2-Methylbenzaldehyde	1.46	0.003	0.06	1.32	0.030	0.18
	p-Tolualdehyde	0.36	0.020	0.15	0.54	0.013	0.06
Hydrocarbons							
	n-Heptane	1.39	0.150	0.39	1.66	0.080	0.28
	n-Hexane	1.85	0.020	0.14	2.06	0.008	0.09
	n-Dodecane	1.71	0.048	0.22	1.94	0.016	0.13
	n-Tridecane	1.51	0.130	0.36	1.66	0.110	0.34
	1-Heptene	1.84	0.001	0.04	2.01	0.001	0.04
	4-Vinyl-1-cyclohexene	1.59	0.040	0.22	1.84	0.010	0.10

(continued)

Table 7 (cont'd)

Chemical Class	Compound	PFB[a]	Var.[b]	S.D.[c]	PFT[a]	Var.	S.D.
Oxygenated hydrocarbons							
	Bis-n-propyl ether	5.90	0.380	0.57	6.40	0.130	0.36
	2-Pentanone	2.64	0.260	0.41	2.94	0.060	0.240
	2-Ethylfuran	2.59	0.230	0.48	2.68	0.100	0.320
	Cyclohexene oxide	1.28	0.030	0.13	1.52	0.030	0.17
Halogenated hydrocarbons							
	Trichloroethylene	2.08	0.14	0.38	2.42	0.49	0.70
	Tetrachloroethylene	2.76	0.21	0.46	3.10	0.78	0.85
	Bis-(chloromethyl)ether	3.70	0.10	0.32	3.57	0.79	0.89
	2,3-Dichlorobutane (Rac.)	1.80	0.03	0.17	2.07	0.04	0.21
	2,3-Dichlorobutane (Meso)	2.01	0.03	0.18	2.16	0.01	0.12
	1-Chloro-2-bromoethane	-	-	-	5.34	0.02	0.14
	Trimethylene chlorobromide	-	-	-	6.54	0.02	0.40
	1,3-Dibromobutane	3.34	0.14	0.37	2.78	0.59	0.76
	[illegible]	3.68	-	-	3.31	1.71	1.31
Chlorinated aromatics							
	Chlorobenzene	2.18	0.007	0.03	2.47	0.04	0.20
	p-Chlorotoluene	2.86	0.04	0.19	2.31	0.01	0.11
	Benzyl chloride	2.08	0.02	0.15	1.68	0.03	0.18
	p-Dichlorobenzene	2.21	0.14	0.38	2.51	0.32	0.56
	Bromobenzene	3.98	-	-	3.08	2.10	1.45
Miscellaneous							
	p-Ethylaniline	1.62	0.170	0.41	1.28	0.060	0.25

[a] PFB = perfluorobenzene, PFT = perfluorotoluene which were external standards.
[b] Var. = statistical variance.
[c] S.D. = standard deviation.

Table 8 (cont'd)

Chemical Class	Compound	M.W.	1st Ion m/e (%)	1st Ion RRR	2nd Ion m/e (%)	2nd Ion RRR
Oxygenated hydrocarbons	3-Ethylfuran	96	81 (100)	2.35	-	-
	2-Pentanone	86	43 (100)	1.98	57 (26)	0.14
	Cyclohexanone oxide	96	85 (100)	0.51	-	-
Hydrocarbons	n-Nonane[b]	128	85 (22)	2.46	71 (28)	2.01
	n-Undecane[b]	156	85 (21)	3.48	156 (4)	0.89
	n-Tridecane[b]	184	71 (41)	3.50	85 (21)	1.99

[a] RRR values relative to m/e 186 (100) for RFA.

[b] RRR values relative to m/e 167 (18) for RFA.

the RRR factor in the event that the first ion saturated the instrument or was non-specific.

The relative response factors were in all cases calculated on the basis of quadruplicate determinations between the authentic compound and the external standard.

DETERMINATION OF THE OVERALL SENSITIVITY OF HIGH RESOLUTION GLC/MS/COMP FOR THE ANALYSIS OF AMBIENT AIR POLLUTANTS

In order to determine the overall utility and sensitivity of the gc/ms/comp technique for the quantification of the ambient air pollutants, the theoretical sensitivity limits were estimated. Based upon the breakthrough volumes for the compounds listed in Table 4 at an ambient air temperature of 70°F, the theoretical sensitivity for the collection, transfer of the organic pollutants from the cartridge to the analytical system and the response of the analytical system to the organic vapor were calculated for a number of compounds. These results are given in Table 9.

The estimated detection limit for a number of halogenated compounds reveals a variation over several orders of magnitude (Table 9). The low detection limits are directly proportional to the sensitivity of the instrumentation to the particular compound and to its breakthrough volume. Thus the higher the breakthrough volume, the lower the anticipated limit of detection for its analysis in ambient air. For example, the volatile compound vinyl bromide has an estimated detection limit of approximately 250 ng/m^3 of ambient air, whereas the estimated detection limit for bromobenzene is 100 pg/m^3 of air (Table 9).

The estimated detection limits for nitrosamines such as N-nitrosodimethylamine can be as low as 1.67 ppt (70°F).

Table 9. OVERALL TECHNICAL CAPABILITY OF EPA METHODS
GAS CHROMATOGRAPHY/MASS SPECTROMETRY/COMPUTER ANALYSIS
FOR ATMOSPHERIC PARTICULATE

Chemical Class		Estimated Detection Limit[a]	
		ng/m^3	ppt
Halogenated hydrocarbon	Vinyl bromide	250	57
	Bromoform	2,340	1,013
	Dibromochloromethane	1,370	0.22
	Bromochloromethane	2,6	0.67
	1-Bromo-2-chloroethane	1,70	2.67
	Allyl bromide	5,80	1,04
	1-Bromopropene	5,200	1,06
	1-Chloro-3-bromopropene	0,130	0.02
	1-Chloro 2,3-dibromopropane	<0,180	<0.01
	1,1-Dibromo-3-chloropropane	<0,730	<0.07
	1,2-Dibromomethane	0,330	0.07
	1,3-Dibromopropane	<0,130	<0.01
	Epichlorohydrin (1-Chloro-2,3-epoxypropane)	9,600	2.5%
	Epibromohydrin (1-Bromo-2,3-epoxypropane)	6,300	0.65
	Bromobenzene	0,100	0.02
	Methyl bromide	500	135
	Methyl chloride	2300	1000
	Vinyl chloride	800	220
	Methylene chloride	700	200
	Chloroform	200	420
	Carbon tetrachloride	250	400

(continued)

Table 9 (continued)

Chemical Class	Compound	Estimated Detection Limit[a]	
		ng/m^3	ppt
Halogenated hydrocarbons (cont'd)	1,2-Dichloroethane	32	8.15
	1,1,1-Trichloroethane	66	12.45
	Tetrachloroethylene	2.5	0.38
	Trichloroethylene	10	1.92
	1-Chloro-2-methylpropene	47	21.5
	3-Chloro-2-methylpropene	62	21.5
	3-Chloro-1-butene	42	28.8
	Allyl chloride	83	28.6
	4-Chloro-1-butene	38	13.2
	1-Chloro-2-butene	13	4.5
	Chlorobenzene	2.10	0.47
	o-Dichlorobenzene	1.90	0.86
	p-Dichlorobenzene	0.75	0.12
	Benzylchloride	0.65	0.02
Halogenated ethers	1-Chloromethyl ethyl ether	4.15	0.97
	Bis-(chloromethyl)ether	1.0	1.10
Nitrocompounds	2-Nitropropane	5.0	1.67
	1-Nitropropane	3.0	0.74
Aldehydes	Acrolein	~200	96.5
	Glycolaldehyde	~50	18.5
	Propionic acid	~40	25.5
	Acrylonic dioxymide	~20	6.7

(continued)

Table 9 (continued)

Chemical Class	Compound	Estimated Detection Limit[a] ng/m^3	ppt
Oxygenated hydrocarbons (continued)	Cyclohexene oxide	~10	2.5
	Styrene oxide	2	0.415
	Acetophenone	~2	~0.415
	β-Propiolactone	~3	~1.2
Nitrogenous Organics	Nitrobenzene	8	~2.4
	Aniline	3.0	0.78
Sulfur Compounds	Diethyl sulfate	~50	-
	Ethyl methane sulfate	~5.0	-

[a] Limits are calculated on the basis of the breakthrough volume for 1.2 g of Tenax GC, (ca. 70°F), capillary column performance and sensitivity of the mass spectrometer to that compound in the mass fragmentography mode of scan between 5m.

SECTION 7

IDENTIFICATION AND QUANTIFICATION OF ORGANIC POLLUTANTS IN AMBIENT AIR FROM SEVERAL GEOGRAPHICAL LOCATIONS

The overall purpose of this program has been to examine ambient air for hazardous organic compounds, particularly those volatile vapors which pass through the conventional Hi-Vol glass fiber filters. In the past very little characterization has been performed on ambient air collected from geographical areas throughout the Continental U.S.

Information on the composition of ambient air is of course particularly important if we are to understand the health effects impact resulting from organic pollutants. The information gathered with regard to the composition and quantity of organic vapors will assist investigators in future studies to determine the epidemiological implications of the pollution which is occurring. Since to-date there is only a paucity of data available with regard to the types of organic pollutants and their concentrations in ambient air, this program was initiated in order to acquire a better understanding of the potential pollution problems confronting the populated areas around the U.S.

CHARACTERIZATION AND QUANTIFICATION OF AMBIENT AIR POLLUTANTS IN THE BALTIMORE, MD AREA

Previous studies on the analysis of ambient air surrounding an industrial site in Baltimore, MD revealed the presence of N-nitrosodimethylamine.[3,6] The quantification of DMN was also performed in the cited studies.[3,7] However, the previous studies on nitrosoamines only represent a small potential health problem since the complete characterization of the ambient air for volatile organics had not been conducted. For this reason, we undertook a study in order to obtain a more complete characterization of the ambient air so as to better understand the health impact of the organic vapor pollutants. Because nitrosoamines were found, it does not necessarily follow that these are the only compounds responsible for the health problems

(e.g. incidence of cancer) for the immediate populace since there is the important aspect of other pollutants interacting antagonistically or synergistically to exert the final health impact observed in humans.

This section presents the characterization and quantification of ambient air pollutants near an industrial area in Baltimore, MD (Fig. 1).

Experimental

The sampling procedure employed for this study has been previously described[2] which consisted of concentrating ambient air pollutants on a 1.5 x 6 cm bed of Tenax GC (35/60) in a glass cartridge. All of the sampling cartridges were preconditioned by heating to 275°C for a period of 20 min under helium purge (20-30 ml/min). Cartridges were cooled in precleaned Kimax® centrifuge tubes. The cartridge containers were immediately sealed to prevent contamination. Cartridges prepared in this manner were carried to the sampling site; 2-3 cartridges were designated as blanks to determine whether any of the cartridges were contaminated by the packing and transportation procedure.

Ambient air samples were collected with a Nutech Model 321-AC/DC portable sampler (Nutech Corp., Durham, NC). In general a sampling rate of 1 ℓ/min/cartridge was used throughout this study (Table 10).

The instrumental system (glc/ms/comp) used for the qualitative and quantitative analysis of ambient air pollutants and the inlet manifold used for recovering vapors trapped on Tenax GC cartridge samplers were as described elsewhere.[3,3] The desorbed vapors were resolved by glass capillary, gas-liquid chromatography and mass cracking patterns were automatically and continuously obtained throughout the glc run with a Varian MAT CH-7 gas chromatograph/mass spectrometer.

The operating parameters for the glc/ms/comp for analysis of samples collected on Tenax GC cartridges from the Baltimore, MD area are shown in Table II. Ambient air samples were analyzed on a 100 m glass SCOT column coated with OV-101 stationary phase. The desorption of ambient air pollutants from the Tenax GC cartridge samplers was conducted at 265-270°C. A single stage glass jet separator interfaced the SCOT capillary column to the mass spectrometer and was maintained at 200°C.

Identification of resolved components was achieved by comparing the mass cracking pattern of the unknown mass spectra to an 8 major peak index

Figure 1. Map of sampling area in East Brooklyn, Baltimore, Maryland

Table 10. [illegible]

Date	Time	Location	Temperature (°F)	RH (%)	Wind	
					Direction	Speed (MPH)
10/24/75	1100–1450	PAC (Parking lot)	83	49–58	[illegible]	10
10/25/75	1300–0750	PAC (Parking lot)	65	90–97	Calm	–
10/26/75	1000–1350	Sewage Plant	72	45–57	[illegible]	9–11
11/19/75	1400–1600	PAC, 200 yd N-NE of Detector thermal detector	65	56	E	3
11/24/75	1150–1350	PAC, 50 yd of Detector thermal detector	–	–	–	–
11/24/75	1355–1555	PAC, 50 yd of Detector thermal detector	–	–	–	–

Table 11. OPERATING PARAMETERS FOR GLC-MS-COMP SYSTEM

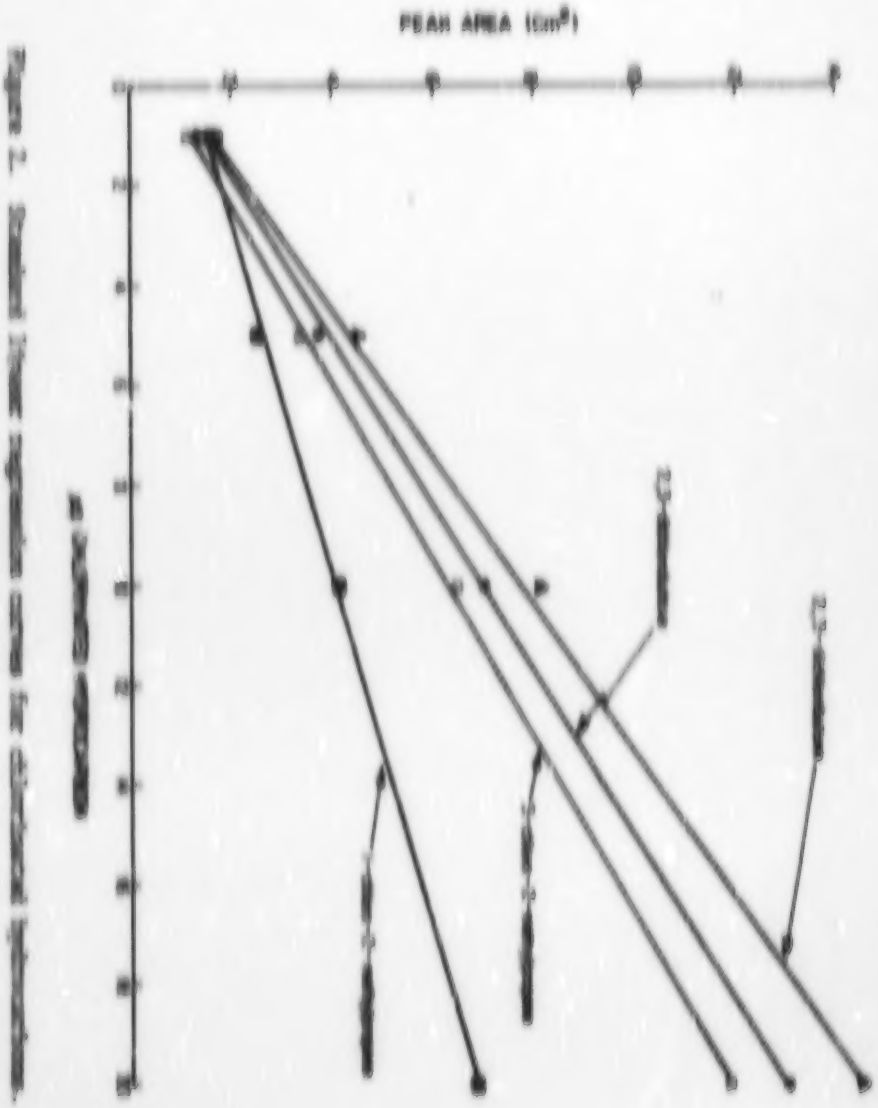
Parameter	Setting
Inlet-manifold	
desorption chamber	265°-270°
valve	175°
capillary trap - minimum	-195°C
maximum	4175°C
thermal desorption time	-4 min
GLC	
OV-101 glass SCOT (100 m)	30-225°C, 4°C/min
carrier (He) flow	1.5 ml/min
MS	
single stage glass jet separator	200°C
ion source vacuum	$\sim 2 \times 10^{-6}$ torr
filament current	300 μA
multiplier	5.5
scan rate, automatic cyclic	1 sec/decade
scan range	m/e 20 - 300

of the mass spectra.[8,9] In several cases the identification was confirmed by comparing the mass spectrum and the elution temperature of the authentic compound with the unknown substance. Particular attention was paid to the relationship between the boiling point of the identified compound and its elution temperature and to the elution of constituents in a homologous series since the OV-101 SCOT capillary column separates primarily on the basis of boiling point.

The halogenated hydrocarbons in ambient air which were identified in these samples were quantitated. Standard curves for the response of the mass spectrometer *vs* the concentration of each of the identified halogenated hydrocarbons were prepared by introducing known quantities of vapor into the glc/ms system. Synthetic air halogenated hydrocarbon vapor mixtures were prepared in specified quantities trapped on Tenax GC cartridges. By thermally desorbing the cartridges and monitoring the total ion current, responses *vs* concentrations were obtained (Fig. 3). Cartridge samplers containing unknown concentrations of each of the halogenated hydrocarbons were analyzed by monitoring the total ion current and obtaining the quantity/cartridge from the standard curve. In those cases where baseline resolution was not achieved by the capillary column the technique of mass fragmentography (Section VI) was used instead of the total ion current. Based on the volume of air sampled and the breakthrough volume for each of the halogenated hydrocarbons (Section VI) the concentrations of the halogenated hydrocarbons in ambient air were calculated.

Results and Discussion

Characterization of Samples.--Figures 3 and 4 depict the profiles observed for ambient air samples taken near the FMC Corporation and the Paraparo Sewage Treatment Plant. A majority of the components shown in Fig. 4 were identified and are listed in Table 18 (Appendix I). In these samples, several halogenated compounds were identified. Those of particular interest were 1-chloro-2-methylpropene (dimethyl vinyl chloride, peak No. 6), 3-chloro-2-methylpropene (peak No. 7), 2,3-dichlorobutane (racemic, peak No. 33), and 2,3-dichlorobutane (meso, peak No. 35). The remaining halogenated compounds were typically of those which have been previously identified at other geographical areas within the Continental U.S.


PEAK AREA (cm²)

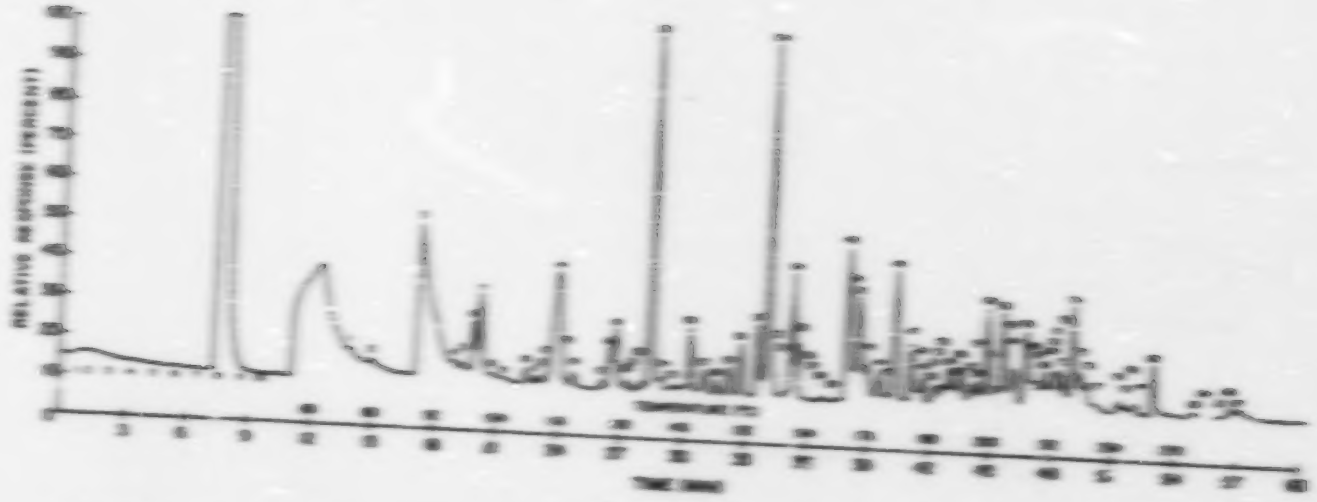


Figure 1. Profile of ambient air pollutants from industrial site in Baltimore, MD using high resolution gas chromatography/mass spectrometry/computer. A 100 m glass SCOT coated with SE-30 stationary phase was used; temperature programmed from 35-230°C @ 4°C/min.

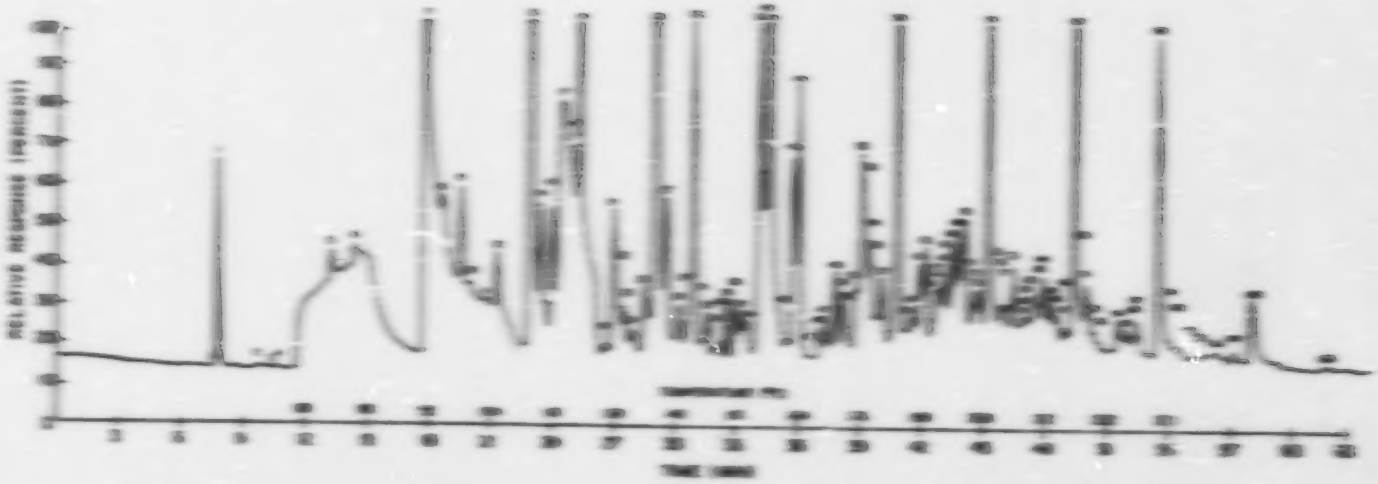


Figure 4. Profile of ambient air pollutants from Patapsco Sewage Treatment Plant in Baltimore, MD using high resolution gas chromatography/mass spectrometry/computer. A 100 m glass SCOT coated with SE-30 stationary phase was used; temperature programmed from 35-230°C @ 4°C/min.

The pollutants in Figure 4 are listed in Table 19 (Appendix I). In contrast to the samples obtained near the industrial site, this sample did not contain any of the previously described halogenated hydrocarbons. Several additional samples were taken in this area, and each revealed the presence of the four halogenated hydrocarbons described above. Because of the sampling strategy employed, it was not possible to attribute the emissions to the most immediate industrial site. The meteorological conditions in combination with the sampling protocol employed did not allow differentiation in the source of these compounds. Tables 19-22 (Appendix I) list additional identified pollutants.

Quantification of Halogenated Hydrocarbons in Ambient Air.--Table 18 depicts the sampling conditions and the concentrations of halogenated hydrocarbons observed in ambient air from an industrial area in Baltimore, MD. On two separate occasions during the month of October and November, the concentration of the four identified halogenated hydrocarbons were determined. The highest concentration observed was for dimethyl vinyl chloride which occurred in samples taken on the FMC property during the evening hours. Dimethyl vinyl chloride reached a level of 670,000 ng/m^3 of ambient air. The lowest levels were approximately 100,000 ng which were detected for the month of November. The second most prominent halogenated hydrocarbon was an isomer of dimethyl vinyl chloride, 3-chloro-2-methylpropene which obtained a level of 400,000 ng/m^3. Inspection of the data reveals that a correlation is evident between the concentrations of each of the halogenated hydrocarbons and the particular sampling time. Since their levels appear to increase and decrease simultaneously, this suggests that the same point source of emission is responsible for all four of the compounds.

In contrast to the above observations for the halogenated hydrocarbons near an industrial site, a sample of ambient air which was taken at the Patapsco Sewage Treatment Plant did not yield any measurable levels of the four halogenated hydrocarbons.

An interesting observation is that 2,3-dichlorobutane may exist as a racemic mixture and also as a meso pair. Although the racemic pair is theoretically possible, we only observed one isomer in the samples in which 2,3-dichlorobutane was detected. Authentic compounds of the four halogenated hydrocarbons were subjected to high resolution gas

[redacted]

chromatography/mass spectrometry and the retention time and mass cracking patterns were determined for the identity of each constituent (Fig. 5). While establishing the retention time of the halogenated hydrocarbons, we observed that an authentic sample of 2,3-dichlorobutane was a racemic mixture. The high resolution glass capillary columns effected baseline separation of the two racemic isomers as well as complete resolution from the meso pair of 2,3-dichlorobutane. Since the various isomeric forms were completely separated, we were able to then deduce whether the meso and racemic pairs were present in the ambient air samples. Indeed the meso form was observed, however only one isomer of the racemic pair was detected. Figure 5 depicts the resolution of the four authentic halogenated hydrocarbons.

ANALYSIS OF AMBIENT AIR FROM THE KANAWHA VALLEY, WV

A study had been conducted in the Kanawha Valley for the analysis of nitrosoamines in ambient air.[6,7] Concurrent with this analysis and under this program, a broader more complete characterization of the organic pollutants in ambient air was also conducted. This section describes the characterization and quantification of organic compounds in ambient air taken from several sites within the Kanawha Valley.

Experimental

Ambient air sampling at several locations in the Kanawha Valley was conducted in a similar manner as described for the Baltimore project. The sampling protocol for selected sites in this valley is given in Table 13. Figures 6 and 7 depict the sampling locations in Belle and South Charleston, WV. The principal sites were on the E. I. DuPont Nemours property in Belle and Union Carbide in South Charleston.

The characterization and quantification of organics were as previously described.

Results and Discussion

The identification and estimation of several organic vapors are given in Tables 33-35 (Appendix I). Many organic vapors were identified. Those of particular interest were vinyl chloride, acetaldehyde, benzene, dimethylformamide, hexyl methacrylate, alkyl amines, chloroform, ethyl acetate, carbon tetrachloride, methyl chloroform, acetone, etc. The concentrations of some of these compounds are given in Table 14.

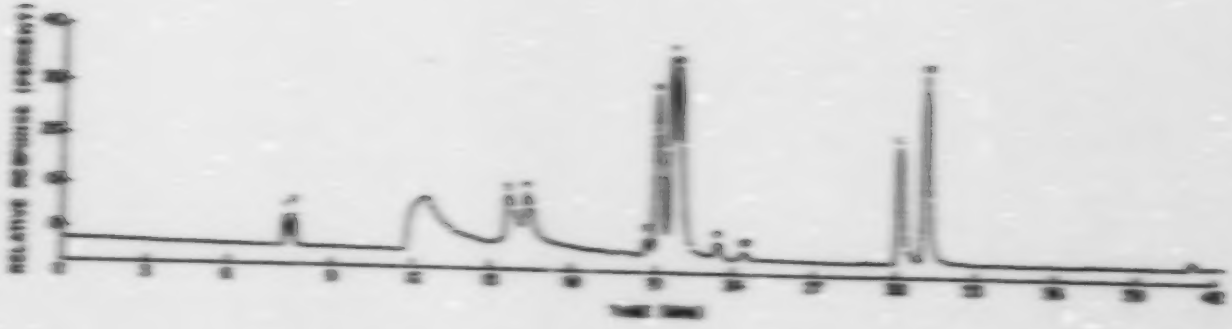


Figure 5. Resolution of standard mixture of chlorinated hydrocarbons using a 90 m glass SCOT coated with SE-30, stationary phase. Temperature programmed from 20-225°C @ 4°C/min.

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

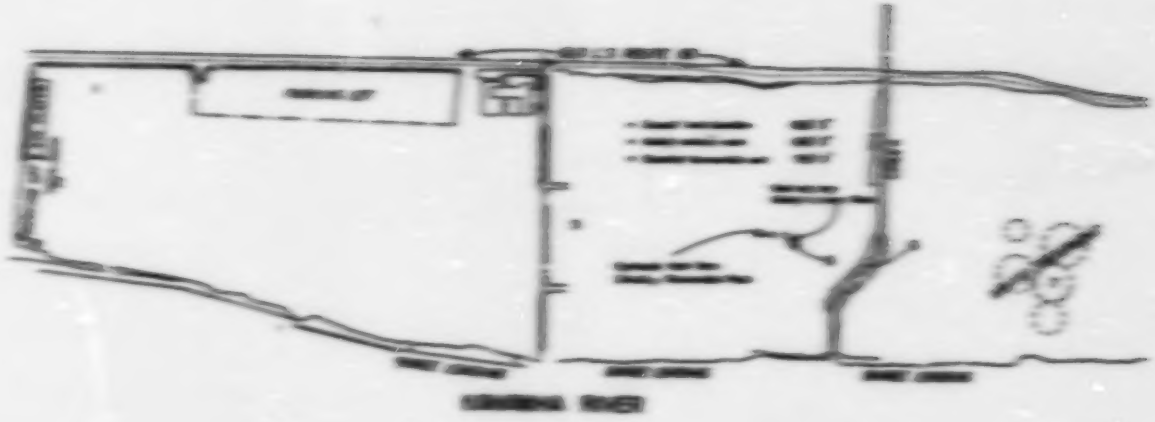


Figure 6. Plant map of Nelson to Bella, W depicting sampling locations.

Figure 2. Plane map of Bahia Cochinos, SW depicting sampling locations.

Table 14. AMBIENT AIR LEVELS OF SEVERAL POLLUTANTS IN THE KANAWHA VALLEY, WV[a]

Compound	Site		
	Belle	South Charleston	Nitro
Vinyl chloride	<2-4,000	trace	30,000
Acetaldehyde	<9,800	trace	trace
Acetone	trace	<100,000	>125,000
Methylene chloride	8,730	trace	>75,000
Chloroform	trace	<105,000	>39,000
Carbon tetrachloride	trace	<60,000	ND
Benzene	<400,000	<140,000	<150,000
N,N-Dimethylformamide	<76,700	ND	ND
γ-Butyrolactone (tent.)	ND[b]	3,750	ND
Ethyl acetate	ND	<70,000	trace

[a]Values are in ng/m^3

[b]ND = not detected

QUALITATIVE AND QUANTITATIVE ANALYSIS OF VOLATILE ORGANIC POLLUTANTS NEAR A CHEMICAL DISPOSAL SITE

The objective of this study was to determine the composition and concentrations of organic volatiles occurring in ambient air near a disposal site in Edison, NJ. The landfill site was located on the north bank of the Raritan River at the end of Hill Road. Large quantities of chemical waste were known to be dumped at this location.

Experimental

The sampling strategy surrounding the disposal site incorporated upwind, downwind and crosswind sampling as well as on the dump mound itself, in order to ascertain which organic vapors were emanating from the landfill itself. Figure 8 depicts the sampling locations surrounding the Kin-Buc landfill in Edison, NJ. Table 15 gives the sampling protocol for investigating this site. The ambient air samples were collected according to the previously described procedure.[2,3]

Collected samples were submitted to glc/ms/comp analysis for either nitrosoamines or complete organic vapor characterization. The analytical protocol for this analysis has also been previously described.[3]

Results and Discussion

No nitrosoamines were detected in all samples examined. The identity of the compounds in samples obtained from upwind and downwind positions as well as on top of the chemical dump are listed in Tables 26-31 (Appendix I). After comparing the results obtained for each of the samples surrounding the chemical dump site, compounds were selected for quantification based on their presence only in samples obtained either on the mound or downwind from the chemical dump site or their extraordinarily high concentrations in ambient air. The concentration of several organic vapors are given in Table 16. Very high concentrations of benzene, dichloromethane, toluene, vinyl methyl ether, vinyl isopropyl ether and methyl chloroform were observed. In addition to several chlorinated hydrocarbons, methylene bromide was identified. This represents the first case in which we have identified this compound in ambient air.

COMPOSITION OF AMBIENT AIR FROM LOS ANGELES, CA BASIN

Sampling was performed in the Los Angeles basin area at locations near major industrial sites. The primary type of industrial activity was the

Figure 8. Sampling locations surrounding Kin-Buc Land-fill, Edison, NJ

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 15 (cont'd)

Sampling Period	Location (No.)[a]	Bearing[b]/Distance[b] (mi.)	Sampling Time (min)	m^3/cartridge	Remarks
	Top of KB Tower	—	11	0.060 5.060	3/25/76 – 3:09 pm–3:17 pm 64°F 30% RH Overcast 30.11" Hg Wind 265–285°, 5–10 mph
	Beehive Rd. (5) (between Stauffer and KB)	345°/0.5	42	0.380	3/25/76 – 4:38 pm–5:02 pm 62°F 42% RH 9/10 Cloudy 30.14" Hg Wind 345°, 2–4 mph (upwind sample)
5	KC Turnpike (3) at Mill Rd.	148°/48.75	130	0.824	3/26/76 – 10:48 am–12:59 pm 60°F 34% RH Clear 30.47" Hg Wind 300–320°, 0–10 mph Shifting to 230° at 12:45 pm (upflank sample)
	Saperville, KC (4) at St. Stanislaus School Rd.	315–325/2.75	130	0.958 0.117	3/26/76 – 10:48 am–12:59 pm As above (downwind sample)

[a] See map (Fig. 6) for location number.

[b] Relative to dump site.

Table 16. [illegible]

Compound	[illegible] (24)	[illegible] (24)	[illegible] (24)	[illegible] (24)	[illegible] (24)	[illegible] –	[illegible] (24)	[illegible] (24)	[illegible] (24)
[illegible]	240	trace	trace	50	trace	trace	trace	trace	trace
[illegible]	200	trace	0.40	trace	15	985	1,550	10	1,220
[illegible]	60	60	60	60	60	trace	1	60	65
[illegible]	3	trace	trace	trace	trace	60	60	56	35
[illegible]	20	trace	40	trace	trace	60	60	trace	trace
[illegible]	trace	15	20	trace	45	266	74	30	120
[illegible]	60	60	60	60	60	27	25	60	5
[illegible]	trace	trace	trace	trace	trace	trace	50	4	trace
[illegible]	125	0.05	0.07	15	trace	1,250	375	0.042	300
[illegible]	60	60	60	60	60	57	35	60	35
[illegible]	50	60	60	60	60	60	60	60	60
[illegible]	60	60	60	35	60	30	25	60	25
[illegible]	60	60	60	60	60	120	17	60	60
[illegible]	100	–	–	20	trace	trace	4,100	trace	trace
[illegible]	60	60	60	60	60	trace	30	60	60
[illegible]	60	60	60	trace	60	260	60	trace	30
[illegible]	60	60	60	60	–	trace	60	60	60
[illegible]	trace	trace	0	30	trace	60	60	trace	60

[illegible]

Table 26 (cont'd)

Component	Location/Sampling Period								
	TM/2 (SW)	TM/3 (SW)	TM/4 (SW)	TP/5 (SW)	NT/5 (SW)	M/4 –	PL/1 (SW)	SA/5 (SW)	PL/2 (SW)
Toluene	–	–	–	–	972	50	2,400	1500	1,500
Trichloroethylene	9	trace	46	trace	13	trace	95	trace	82
1,1,1-Trichloroethane	trace	0.03	48	0.04	trace	500	25	0.03	5
Tetra.chloroethylene	trace	trace	trace	8	trace	142	trace	60	26
Vinyl methyl ether	80	90	90	80	trace	5,000	80	90	90
Vinyl isopropyl ether	80	90	90	90	trace	13,000	80	90	90

[a] Values are in $\mu g/m^3$.

[b] TM = Tower Marina, TP = spatial, NT = NJ Turnpike, M = mound, PL = Parkland, SA = Sayreville, NT = Stauffer and SW = downwind

synthesis, storage and usage of organic chemicals. Because of these types of activities sampling was performed near this industrial area in order to ascertain whether emissions might occur of volatile organic compounds which may have health effect implications.

Experimental

The sampling and analytical methods employed in this study were as described earlier. The sampling protocol is listed in Table 17 and their locations are given in Figures 9-11. In the first case, sampling was conducted at 15th and Emery Street in Los Angeles, which was a location downwind from a chemical company and in the second case a location at 2055 203rd Street. The second location was also downwind from an industrial chemical area.

Results and Discussion

Tables 34-36 list the organic pollutants vapors which were identified at the locations given in Table 17. The ambient air sample from the 15th and Emery Street location contained several halogenated compounds of interest. These were: methyl chloride, ethyl chloride, carbon tetrachloride, trichloroethylene. Two esters were also identified: isobutyl acetate and n-butyl acetate. In a second sample taken from this location, mono vinyl glycol ether. An ambient air sample from Dominques, CA contained several halogenated compounds. These were methyl chloride, ethyl chloride, 1,1,-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, 1,1,2-trichloroethane and trichlorobenzene. Generally these chlorinated compounds are not ubiquitous. Other halogenated hydrocarbons were also detected, however these have occurred in many ambient air samples analyzed from several different geographical areas around the Continental U.S.

The concentrations of selected organic volatile pollutants in ambient air samples from the Los Angeles Basin area are also given in Table 34-36.

Figure 1. Map depicting sampling locations in Los Angeles, CA

Figure 10. Map depicting sampling sites in Los Angeles, CA.

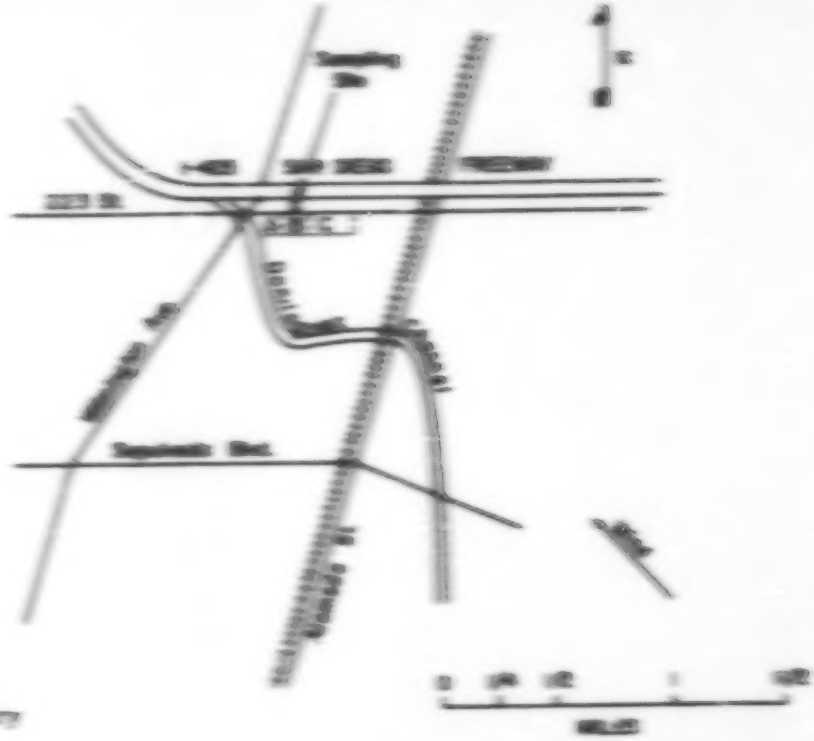


Figure 11. Map depicting sampling locations in Dominguez, CA

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APPENDIX A
VOLATILE ORGANICS IDENTIFIED AND QUANTIFIED IN AMBIENT AIR

Table 18. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM BALTIMORE, MD[a]

Peak No.	Time (s)	Compound
	70	tetrachloroethylene/methane
1	75	C_5H_{12} isomer
2	80	methylene chloride
3	89	trimethylethanol (TBE)
4	96	unknown
5	98	chloroform
6	99	1-chloro-2-methylpropane
7	101	2-chloro-2-methylpropane
8	103	C_6H_{14} isomer
9	105	1,1,1-trichloroethane
10	110	benzene
10A	110	carbon tetrachloride
11	111	C_6H_{14} isomer
12	113	C_7H_{16} isomer
13	117	C_7H_{16} isomer
14	118	tetramethylbutylbenzene
15	118	dibromomethane
15A	119	trichloroethylene
16	119	C_7H_{16} isomer
16A	119	C_7H_{16} isomer
17	121	C_8H_{18} isomer
18	126	C_8H_{18} isomer
19	127	1,1-dichloro-1-methylpropane (tent.)
20	129	C_8H_{18} isomer
21	131	C_8H_{18} isomer
22	132	2,3-dichlorobutane (tentative)
23	135	toluene
23A	135	C_8H_{18} isomer
24	136	2,3-dichlorobutane (tent.)
25	138	C_8H_{18} isomer
25A	140	C_8H_{18} isomer
26	142	p-xylene
26A	142	p-tetrachloroethylbenzene
27	144	tetrachloroethylene
28	146	dichlorobutane isomer
29	149	1,3-dichloro-2-methylpropane (tent.)
30	151	chlorobenzene
31	155	ethylbenzene
32	156	p-xylene
33	158	dibromochlorofluoromethane
34	160	styrene
35	161	p-xylene
36	164	p-xylene
37	171	$C_{10}H_{22}$ isomer
38	167	tetrachloroethane
39	170	$C_{10}H_{22}$ isomer
40	171	C_9H_{18} isomer
41	172	tetrachloropropane isomer (tent.)
42	173	tetrachlorobutane isomer (tent.)
43	175	C_9-alkyl benzene
43A	176	$C_{10}H_{22}$ isomer
44	178	C_9-alkyl benzene
45	178	C_9-alkyl benzene
46	180	$C_{10}H_{22}$ isomer
47	181	p-bromine
47A	181	C_9-alkyl benzene
48	183	p-dichlorobenzene
49	186	$C_{10}H_{22}$ isomer
49A	186	C_9-alkyl benzene
50	187	C_9-alkyl benzene
51	188	C_9-alkyl benzene
52	189	p-dichlorobenzene
52A	189	C_9H_{20} isomer
53	191	C_9-alkyl benzene
53A	191	trimethylphenanthrene
54	191	C_9-alkyl benzene
55	192	C_9-alkyl benzene
56	193	$C_{10}H_{22}$ isomer
57	194	C_9-alkyl benzene
58	195	C_9-alkyl benzene
59	197	C_9-alkyl benzene
60	198	$C_{10}H_{22}$ isomer
61	199	p-undecane
62	201	methylene dicyclohexane isomer (tent.)
63	203	C_9-alkyl benzene
64	204	C_9-alkyl benzene
65	205	C_9-alkyl benzene
66	207	C_9-alkyl benzene
66A	207	$C_{11}H_{24}$ isomer
66B	208	$C_{10}H_{20}$ isomer
67	209	$C_{10}H_{20}$ isomer
68	210	$C_{10}H_{22}$ isomer
70	211	C_9-alkyl benzene
71	212	C_9-alkyl benzene
72	213	1-butylcyclohexene
73	215	C_9-alkyl benzene
74	215	trichlorobenzene isomer
75	216	p-xylene

(continued)

Table 18 (cont'd)

Chromatographic Station Graphic Peak No.	Temp (°C)	Compound	DBA Jupiter Station Graphic Peak No.	Temp (°C)	Compound
76	317	naphthalene			
77	318	$C_{12}H_{18}$ isomer			
78	320	C_3-alkyl benzene isomer			
79	325	C_3-alkyl benzene isomer			
80	326	$C_{13}H_{20}$ isomer			
81	328	$C_{13}H_{20}$ isomer			
82	330	$C_{13}H_{22}$ isomer			
83	338	n-tridecane			

[a] Ambient air sampled at site 1 (Fig. 1) on 10/14/75 from 1100-1450 hr (Table 10).

Table 19. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM BALTIMORE, MD[a]

Chromatographic profile: Peak No.	Elution temp. (°C)	Compound
1	73	chloroethane
3A	74	trichlorofluoromethane
6	77	n-pentane
6A	81	C_5H_{10} isomer
6B	83	methylene chloride
6C	86	acetone
7	92	trimethylsilanol
8	93	C_6H_{14} isomer
9	98	C_6H_{14} isomer
10	100	chloroform
11	103	C_6H_{12} isomer
12A	106	1,1,1-trichloroethane
12B	109	C_7H_{16} isomer
13	113	benzene
14	114	C_7H_{16} isomer
15	115	C_7H_{16} isomer
16	116	C_7H_{16} isomer
17	118	hexamethylcyclotrisiloxane
18	121	C_7H_{14} isomer
20	126	C_8H_{18} isomer
21	126	dimethylpentane isomer
22	128	C_7H_{14} isomer
23	130	C_7H_{16} isomer
24	131	C_8H_{18} isomer
25	136	hexanol isomer
26	136	toluene
27	138	C_8H_{18} isomer
28	141	C_8H_{18} isomer
30	143	n-octane
31	145	m/e 75 (DMFS) trace
32	146	tetrachloroethylene
33	148	C_9H_{20} isomer
34	149	C_9H_{20} isomer
35	150	C_9H_{20} isomer
36	151	C_8H_{16} isomer
37	153	chlorobenzene
38	154	C_8H_{16} isomer
39	155	ethylbenzene
40	157	C_9H_{20} isomer
41	158	p-xylene
41A	160	dibromochloromethane
42	162	styrene
43	163	o-xylene
45	165	n-nonane
45	166	$C_{10}H_{22}$ isomer
46	168	C_9H_{18} isomer

Chromatographic profile: Peak No.	Elution temp. (°C)	Compound
47	169	tetrachlorobenzene
48	171	$C_{10}H_{22}$ isomer
49	172	C_9H_{18} isomer
50	173	cyclohexanone (cont.)
51	175	n-propylbenzene
52	176	m-ethyltoluene
53	177	p-ethyltoluene
54	178	1,3,5-trimethylbenzene
56	179	$C_{10}H_{20}$ isomer
57	180	1,2,4-trimethylbenzene
57A	180	o-ethyltoluene
58	183	n-decane
59	185	C_3-alkyl benzene
60	186	C_3-alkyl benzene
61	187	$C_{11}H_{24}$ isomer
62	189	1,2,3-trimethylbenzene
63	191	$C_{11}H_{24}$ isomer
64	191	m-dichlorobenzene
65	191.5	$C_{10}H_{20}$ isomer
66	192	trimethylphenoxysilane
68	193	C_3-alkyl benzene
69	195	C_3-alkyl benzene
70	196	acetophenone
71	198	C_3-alkyl benzene
72	198	C_3-alkyl benzene
74	199	$C_{10}H_{22}$ isomer
74	201	n-undecane
75	203	$C_{11}H_{24}$ isomer
76	204	$C_{10}H_{20}$ isomer
77	205	C_3-alkyl benzene
78A	206	C_3-alkyl benzene
79	207	3,5-dimethylacetophenone
80	208	C_3-alkyl benzene
81	210	$C_{11}H_{22}$ isomer
83	211	$C_{12}H_{26}$ isomer
84	211	$C_{12}H_{26}$ isomer
85	213	$C_{10}H_{22}$ isomer
86	215	C_3-alkyl benzene
87	216	C_3-alkyl benzene
89	217	C_3-alkyl benzene
91	217.5	n-dodecane
91	220	naphthalene
92	221	$C_{12}H_{26}$ isomer
94	222	C_3-alkyl benzene
96	226	$C_{12}H_{26}$ isomer
98	235	C_3-alkyl benzene

(continued)

Table 19 (cont'd)

Chromatographic Peak No.	Elution Temp. (°C)	Compound	Chromatographic Peak No.	Elution Temp. (°C)	Compound
95	210	$C_{14}H_{10}$ isomer			
97	230	$C_{14}H_{10}$ isomer			
98	230	p-triphenylene			

[a]Ambient air sampled at Site 2 (Fig. 1), Patapsco Sewage Treatment Plant on 10/16/76 from 1000-1350 hr, see Table 10 for sampling protocol.

Table 20. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM BALTIMORE, MD[a]

Chromato-graphic Peak No.	Elution Time (s)	Compound
1	53	n-propane
2	56	SO_2
3	59	C_4H_{10} isomer
3A	60	chloroethane
3B	62	2-methylpropane
4	63	n-butane
4A	64	2-butene
5	72	isopentane
5A	73	$CFCl_3$
6	75	C_5H_{10} isomer
7	76	n-pentane
8	78	C_5H_{10} isomer
9	80	C_5H_{10} isomer
10	81	methylene chloride
10A	82	acetone
11	87	unknown
11A	87	2-butanol
12	88	C_6H_{12} isomer
13	90	trimethylsilanol, (TMS)
14	94	3-methylpentane
15	95	C_6H_{14} isomer
16	97	n-hexane
16A	98	2-methyl-3-buten-2-ol (tent.)
17	99	chloroform
18	101	1-chloro-2-methylpropane
19	103	3-chloro-2-methylpropene
20	105	methylcyclopentane
21	107	2-butanone
21A	107	1,1,1-trichloroethane
22	110	C_6H_{10} isomer
23	111	benzene
23A	111	CCl_4
24	113	cyclohexane
24A	113	2,3-dimethylpentane
25	118	C_7H_{10} isomer
26	117	C_7H_{14} isomer
27	119	trichloroethylene
28	120	n-heptane
29	123	C_7H_{14} isomer
30	124	C_7H_{14} isomer
31	126	C_8H_{16} isomer
32	129	C_7H_{12} isomer
33	129	C_7H_{12} isomer
34	131	C_8H_{16} isomer
35	133	C_8H_{16} isomer
35A	133	2,5-dichlorobutane (tent.)
36	134	toluene
37	137	C_8H_{16} isomer
37A	138	2,4-dichlorobutane (tent)
38	140	C_8H_{16} isomer
39	141	C_8H_{16} isomer
40	144	n-octane
41	145	C_9H_{18} isomer
42	145	tetrachloroethylene
43	147	C_9H_{20} isomer
44	148	C_9H_{20} isomer
45	149	C_9H_{20} isomer
46	150	C_9H_{18} isomer
47	151	C_9H_{20} isomer
48	153	chlorobenzene
49	155	ethylbenzene
50	157	m- & p-xylene
51	160	C_9H_{20} isomer
52	161	cyclooctatetraene
53	162	p-xylene
54	163	n-nonane
55	165	C_9H_{18} isomer
56	166	C_9H_{18} isomer
57	168	C_9H_{18} isomer
58	169	isopropylbenzene
59	170	$C_{10}H_{22}$ isomer
60	171	$C_{10}H_{22}$ isomer
61	172	C_9H_{18} isomer
62	173	1,4-dichloro-2-butene
62A	173	1,2,3-trichloropropane (tent.)
62B	173	1,1,2,3-tetrachloro-2-methyl-propane (tent.)
63	176	n-propylbenzene
64	175	benzaldehyde
65	176	m-ethyltoluene
66	177	1,3,5-trimethylbenzene
67	178	$C_{10}H_{20}$ isomer
68	179	p-ethyltoluene
69	181	1,2,4-trimethylbenzene
69A	182	n-decane
70	184	$C_{10}H_{22}$ isomer
71	186	m-dichlorobenzene
72	188	C_9-alkyl benzene isomer
73	188	1,2,3-trimethylbenzene
74	189	benzene
75	190	p-dichlorobenzene
76	192	C_9H_{10} isomer

(continued)

Table 30 (cont'd)

Chromatographic Peak No.	Fraction Type: TCT	Compound	Chromatographic Peak No.	Fraction Type: TCT	Compound
77	191	C_4-alkyl benzene isomer			
78	192	C_4-alkyl benzene isomer			
79	193	C_4-alkyl benzene isomer			
80	194	$C_{11}H_{24}$ isomer			
81	195	C_4-alkyl benzene isomer			
82	197	C_4-alkyl benzene isomer			
83	198	$C_{10}H_{18}$ isomer			
84	199	C_4-alkyl benzene isomer			
85	200	n-undecane			
86	201	$C_{11}H_{22}$ isomer			
87	202	$C_{11}H_{22}$ isomer			
88	203	C_5-alkyl benzene isomer			
89	204	C_5-alkyl benzene isomer			
90	205	C_5-alkyl benzene isomer			
91	207	C_5-alkyl benzene isomer			
92	208	$C_{10}H_{12}$ isomer			
93	210	$C_{11}H_{22}$ isomer			
94	211	C_5-alkyl benzene isomer			
95	211	C_5-alkyl benzene isomer			
96	213	C_5-alkyl benzene isomer			
97	214	C_5-alkyl benzene isomer			
98	214	C_5-alkyl benzene isomer			
99	215	C_5-alkyl benzene isomer			
100	217	n-dodecane			
101	218	naphthalene			
102	220	C_6-alkyl benzene isomer			
103	220	C_6-alkyl benzene isomer			
	Isothermal				
104		864			
105		864			
107	230	864			
	Isothermal				
108		864			
109		864			
110		864			
111		864			
112		864			

[a] Ambient air sampled at Site 1 (Fig. 1) on 10/14/76 from 2300-0250 hr, see Table 10 for sampling protocol.

Table 21. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM BALTIMORE, MD[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
1	57	acetaldehyde
2	73	benzene
2A	75	C_5H_{10} isomer
2B	76	furan
3	76	C_5H_{10} isomer
3A	77	n-pentane
4	78	acetone
5	83	dichloromethane
6	86	carbon disulphide
7	91	2-methylpentane
8	96	3-methylpentane
9	97	C_6H_{14} isomer
10	99	n-hexane
10A	100	C_6H_{12} isomer
11	101	chloroform
12	103	C_7H_{16} isomer
12A	104	2-methylfuran
13	105	C_7H_{16} isomer
14	106	C_7H_{16} isomer
15	107	methylcyclopentane
15A	108	C_7H_{14} isomer
16	109	cyclohexadiene or C_6H_{10} isomer
16A	110	1,1,1-trichloroethane
17	113	hexadiene isomer
18	114	benzene
18A	115	CCl_4
19	117	2-methylhexane and cyclohexane
20	118	2,3-dimethylpentane
21	119	3-methylhexane
21A	120	C_7H_{14} isomer
22	122	dimethylcyclopentane isomer
23	123	C_7H_{14} isomer
23A	124	trichloroethylene
24	125	n-heptane
25	126	C_7H_{14} isomer
25A	128	C_7H_{12} isomer
25B	129	C_7H_{14} isomer
26	129	C_8H_{16} isomer
26A	130	C_8H_{16} isomer
27	131	C_8H_{16} isomer
27A	132	C_8H_{16} isomer
28	133	methylcyclohexane
28A	133	C_8H_{16} isomer
29	134	C_8H_{16} isomer
29A	135	C_8H_{16} isomer
30	136	C_8H_{16} isomer

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
31	137	trimethylcyclopentane isomer
32	138	C_8H_{16} isomer and trimethylcyclopentane isomer
33	141	toluene
33A	142	C_8H_{14} isomer
34	143	C_8H_{18} isomer
35	145	C_8H_{16} isomer
35A	146	C_8H_{16} isomer
36	149	n-octane
36A	150	2-nitrosodimethylamine fraction
36B	151	C_8H_{16} isomer
37	153	tetrachloroethylene
37A	153	C_8H_{16} isomer
37B	153	C_8H_{16} isomer
38	154	C_9H_{20} isomer
39	155	C_9H_{20} isomer
40	156	C_9H_{20} isomer
40A	157	C_8H_{16} isomer
41	158	C_9H_{20} isomer
42	159	ethylcyclohexane + C_8H_{16} isomer
42A	159	chlorobenzene
43	160	C_8H_{16} isomer
43A	161	C_9H_{20} isomer
43B	162	C_8H_{16} isomer
44	164	ethylbenzene
45	165	p-xylene
46	167	m-xylene
46A	168	C_8H_{16} isomer
47	169	styrene
48	170	o-xylene
49	171	n-nonane
50	172	C_8H_{16} isomer
50A	173	$C_{10}H_{22}$ isomer
50B	173	$C_{10}H_{22}$ isomer
51	176	$C_{10}H_{20}$ isomer
52	177	isopropylbenzene + $C_{10}H_{22}$ isomer
53	179	$C_{10}H_{22}$ isomer
54	180	$C_{10}H_{20}$ isomer
55	181	$C_{10}H_{20}$ isomer
56	183	n-propylbenzene
56A	183	$C_{10}H_{22}$ isomer
57	184	m-ethyltoluene
58	185	$C_{10}H_{22}$ isomer
58A	187	$C_{10}H_{22}$ isomer

(continued)

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Table 21 (cont'd)

Chromatographic Peak No.	Elution Type: I.S.	Compound	Chromatographic Peak No.	Elution Type: I.S.	Compound
59	188	$C_{11}H_{24}$ isomer			
59A	190	$C_{12}H_{20}$ isomer			
60	191	1,2,4-trimethylbenzene + n-decane			
61	192	$C_{11}H_{24}$ isomer			
62	193	$C_{11}H_{24}$ isomer			
62A	194	$C_{11}H_{22}$ isomer			
63	195	$C_{11}H_{24}$ isomer			
64	196	$C_{11}H_{22}$ isomer			
65	197	$C_{11}H_{24}$ isomer			
66	199	$C_{12}H_{26}$ isomer			
67	201	$C_{12}H_{26}$ isomer			
68	204	$C_{11}H_{24}$ isomer			

[a] Ambient air was sampled 15 ft from dimazine facility at Site 1 (Fig. 1) on 11/19/75 from 1400-1600 hr, see Table 10 for sampling protocol.

Table 22. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM BALTIMORE, MD[A]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound
1	29	CS_2
1A	34	1-butene
2	35	n-butane
3A	37	3-butene
4	39	acetaldehyde
4A	45	C_5H_{10} isomer
5	46	isopentane
6	47	C_5H_{10} isomer + fu.an
6A	49	C_5H_{10} isomer
7	50	n-pentane
8	51	acetone
9	54	dichloromethane
10	56	carbon disulphide
11	58	methyl ethyl ketone
12	59	2-methylpentane
13	61	C_6H_{12} isomer
14	63	n-hexane
15	69	chloroform
16	70	C_7H_{16} isomer
17	72	C_6H_{12} isomer
17A	74	p-xylene isomer
18	76	methylcyclopentane
18A	77	cyclohexane isomer
19	78	1,1,1-trichloroethane
20	80	C_6H_{12} isomer
21	82	benzene
21A	83	carbon tetrachloride
22	87	2-methylhexane
23	88	cyclohexane
24	89	3-methylhexane
24A	91	C_7H_{16} isomer
25	93	dimethylcyclopentane isomer
25A	97	n-pentanone
26	99	C_7H_{16} isomer
26A	100	n-pentanone (cont.)
27	101	trichloroethylene
28A	105	n-heptane
28B	109	C_7H_{14} isomer
28C	107	C_7H_{14} isomer
27	108	C_7H_{14} isomer
27A	109	C_8H_{18} isomer
28	110	methylpentanone isomer of C_8H_{18} isomer
29	112	methylcyclohexane
30	113	C_8H_{16} isomer
31	114	C_8H_{16} isomer
32	116	trimethylcyclopentane
33	117	C_8H_{16} isomer
33A	118	C_8H_{16} isomer
33B	119	C_8H_{16} isomer
34	120	toluene
34A	122	C_8H_{16} isomer
35	123	C_8H_{16} isomer
36	123	C_8H_{16} isomer
37	126	n-octane
37A	129	4-nitrosodimethylaniline (trace)
37B	129	C_9H_{18} isomer
38	131	tetrachloroethylene
39	132	C_9H_{18} isomer
40	133	C_9H_{20} isomer
41	134	C_9H_{20} isomer
42	136	C_9H_{20} isomer
43	137	C_9H_{20} isomer
43A	138	C_9H_{18} isomer
44	140	chlorobenzene
44A	140	C_9H_{18} isomer
45	141	ethylbenzene
46	141	p-xylene
47	144	C_9H_{20} isomer
48	147	o-chlorotoluene
49	148	m-xylene
49A	149	C_9H_{18} isomer
50	150	o-xylene
51	151	$C_{10}H_{22}$ isomer
52	153	isopropylbenzene
53	156	$C_{10}H_{20}$ isomer
53A	157	$C_{10}H_{22}$ isomer
54	158	$C_{10}H_{20}$ isomer
55	159	$C_{10}H_{18}$ isomer
56	160	n-propylbenzene
57	161	m-ethyltoluene
58	163	$C_{10}H_{22}$ isomer
59	164	$C_{10}H_{22}$ isomer
60	166	$C_{10}H_{22}$ isomer
60A	167	o-methylstyrene and $C_{10}H_{18}$ isomer
61	168	1,3,5-trimethylbenzene
62	169	$C_{10}H_{22}$ isomer or n-decane
62A	170	$C_{11}H_{24}$ isomer
63	170	p-chlorotoluene
64	173	$C_{11}H_{16}$ isomer

(continued)

Table 22 (cont'd)

Chromatographic Peak No.	Elution Temp. (°C)	Compound	Chromatographic Peak No.	Elution Temp. (°C)	Compound
65	193	$C_{11}H_{24}$ isomer and 1,3,5-trimethylbenzene			
66	194	$C_{11}H_{24}$ isomer			
67	196	$C_{11}H_{24}$ isomer			
67A	197	indene			
68	198	$C_{11}H_{24}$ isomer and indene and sec-butylbenzene			
69	199	tert-butylbenzene and p-cymene			
70	200	$C_{11}H_{24}$ isomer			
71	202	$C_{11}H_{24}$ isomer			
71A	203	C_3-alkyl benzene isomer			
72	204	$C_{11}H_{24}$ isomer			
73	205	$C_{11}H_{24}$ isomer			
73A	205	C_3-alkyl benzene isomer			
73B	206	ethylstyrene isomer and $C_{10}H_{22}$ isomer			
74	207	$C_{11}H_{24}$ isomer			
75	208	$C_{12}H_{26}$ isomer			
77	211	$C_{12}H_{26}$ isomer			
78A	215	$C_{12}H_{26}$ isomer			
79	217	$C_{12}H_{26}$ isomer			
80	219	$C_{12}H_{26}$ isomer			

[a]Ambient air was sampled near dimasina facility at Site 1 (Fig. 1) on 11/24/75 from 1355-1555 hr, see Table 10 for sampling protocol.

Table 23. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM BELLE, WV[a]

Chromatographic Peak No.	Elution Temp. (°C)	Compound	ng/m³
1	03	CF_2Cl_2	
2	03	chloromethane	
3	04	n-propane	
4	09	vinyl chloride	3-4,200
4A	09	dimethyl ether	
5	09	acetaldehyde	9,000
6	14	n-butane	
7	01	isopentane	
8	01	acetone	
8A	01	trichlorofluoromethane	
9	06	diethyl ether	
10	20	methylene chloride	8,700
11	101	trimethyl silanol	
12	104	3-methylpentane	
13	106	n-hexane	
13A	107	1,1-dimethyl-2-butanol	
14	108	n-hexane	
14A	109	$CHCl_3$	
15	114	C_7H_{16} isomer	
16	116	C_6H_{12} isomer	
17	118	1,1,1-trichloroethane	
18	118	C_7H_{14} isomer	
19	120	m/e 71	
20	122	benzene	100,000
21	124	C_7H_{16} isomer	
21A	125	CCl_4	
22	126	cyclohexane	
23	126	alkane compound (800)	
24	127	alkane compound (800)	
25	128	C_7H_{14} isomer	
26	130	trichloroethylene	
27	131	methyl methacrylate	
28	135	C_8H_{18} isomer	
29	136	C_7H_{14} isomer	
30	139	C_8H_{18} isomer	
31	140	C_7H_{14} isomer	
32	141	C_8H_{18} isomer	
33	142	C_8H_{18} isomer	
34	143	octane	
35	146	C_8H_{18} isomer	
36	147	C_8H_{16} isomer	
37	148	C-methyl formamide	15,100
38	151	C_8H_{16} isomer	
39	151	n-octane	
40	154	tetrachloroethylene	
41	156	C_9H_{20} isomer	

Chromatographic Peak No.	Elution Temp. (°C)	Compound	ng/m³
42	159	C_9H_{18} isomer	
42A	161	C_8H_{16} isomer	
43	160	C_8H_{16} isomer	
44	161	ethylbenzene	
45	163	C_9H_{18} isomer	
46	163	m-xylene	
47	165	C_9H_{20} isomer	
48	169	cyclooctatetraene	
48A	169	styrene	
49	169	p-xylene	
50	170	n-nonane	
51	171	C_9H_{18} isomer	
52	173	iso-propylbenzene	
53	177	$C_{10}H_{22}$ isomer	
54	179	C_9H_{18} isomer	
55	180	C_9H_{18} isomer	
56	180	C_9H_{18} isomer	
57	181	p-ethyltoluene	
57A	181	benzaldehyde	
58	181	p-ethyltoluene	
59	181	hexyl methacrylate	
60	183	C_3-alkyl benzene isomer	
61	183	p-ethyltoluene	
62	190	n-decane	
63	191	$C_{10}H_{20}$ isomer	
64	192	p-dichlorobenzene	
65	194	$C_{11}H_{24}$ isomer	
66	195	C_3-alkyl benzene isomer	
67	196	$C_{11}H_{24}$ isomer	
68	199	C_3-alkyl benzene isomer	
69	201	C_3-alkyl benzene isomer	
70	203	acetophenone	
71	203	$C_{11}H_{24}$ isomer	
72	205	C_3-alkyl benzene isomer	
73	206	C_3-alkyl benzene isomer	
74	208	n-undecane	
75	209	$C_{10}H_{20}$ isomer	
76	210	$C_{10}H_{20}$ isomer	
77	214	C_3-alkyl benzene isomer	
78	213	C_3-alkyl benzene isomer	
79	214	C_3-alkyl benzene isomer	
80	216	C_3-alkyl benzene isomer	
81	216	$C_{10}H_{20}$ isomer	
82	219	$C_{10}H_{22}$ isomer	
83	223	C_3-alkyl benzene isomer	
84	223	$C_{10}H_{20}$ isomer	

(continued)

Table 23 (cont'd)

Chromatographic Peak No.	Elution Time (hr)	Compound	µg/m³	Chromatographic Peak No.	Elution Time (hr)	Compound	µg/m³
65	116	$C_{13}H_{12}$ isomer					
66	116	m-terphenyl					
67	117	naphthalene					
68	118	C_{18}-alkyl toluene isomer					
69	118	p-terphenyl					

[a] Ambient air was sampled at location No. 6, see Table 13 for protocol.

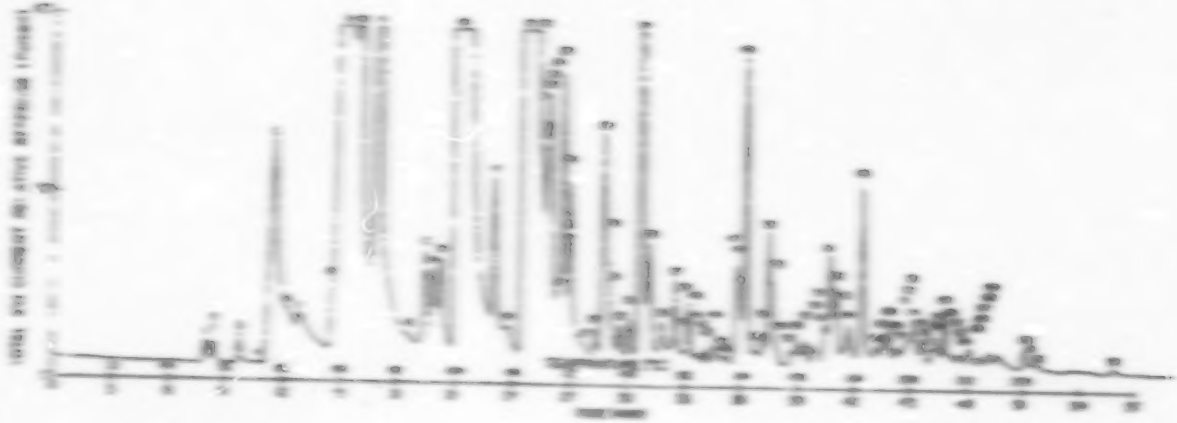

Figure 12. Total ion current profile of ambient air sample taken at location no. 9 on Union Carbide property. See Tables 13 and 24 for protocol and listing, respectively.

Table 24. VOLATILE ORGANIC VAPORS IN AMBIENT AIR FROM SOUTH CHARLESTON, WV[a]

Chromatographic Peak No.	Station Type (TC)	Compound	ng/m³
1	02	$N_2 + O_2$	
2	04	CO_2	
3	05	propane	
4	06	ethyl chloride	trace
5	07	acetaldehyde	
6	09	n-butane	
7	11	methyl ether (tent.)	
8	14	isopentane	
9	15	diethyl ether	
10	16	propanol	1,200,000
11	17	acetone	
12	21	diethyl ether	
13	27	methylene chloride	
14	29	C_6H_{14} isomer	
15A	30	C_6H_{14} isomer	
15	33	n-butyraldehyde (tent.)	3,750
16	101	3-methylpentane	
16A	104	n-hexane	
16B	105	chloroform	1,175,000
16C	106	ethyl acetate	
17	111	C_6H_{12} isomer	
18	113	1,1,1-trichloroethane	
19A	119	benzene	1,200,000
19B	119	carbon tetrachloride	
19C	120	cyclohexane	
20	121	C_7H_{16} isomer	
21	123	C_7H_{16} isomer	
22	125	C_7H_{16} isomer	
23	129	C_7H_{14} isomer	
24	130	trichloroethylene	
25	135	n-heptane	
27	136	C_8H_{18} isomer	
28	137	C_8H_{18} isomer	
29	139	C_7H_{14} isomer	
30	140	C_8H_{18} isomer	
31	141	C_8H_{18} isomer	
32	145	C_8H_{18} isomer	
33	150	C_8H_{18} isomer	
34	152	toluene	
35	155	C_8H_{18} isomer	
36	157	C_8H_{16} isomer	
37	159	n-octane	
38	161	C_8H_{16} isomer	
39	162	C_9H_{20} isomer	
40	163	tetrachloroethylene	
41	164	C_9H_{20} isomer	
42	165	C_9H_{18} isomer	
43	166	C_9H_{20} isomer	
44	168	C_9H_{18} isomer	
45	169	C_9H_{18} isomer	
46	171	C_9H_{18} isomer	
47	173	ethylbenzene	
48	174	C_9H_{20} isomer	
49	175	p-xylene	
50	177	C_9H_{20} isomer	
51	179	styrene	
52	179	p-xylene	
53	179	p-nonane	
54	173	C_9H_{18} isomer	
55	171	C_9H_{18} isomer	
56	175	cumene	
57	178	$C_{10}H_{22}$ isomer	
58	189	$C_{10}H_{22}$ isomer	
59	181	alpha-pinene	
60	182	p-propylbenzene	
61	183	p-ethyltoluene	
62	184	1,3,5-trimethylbenzene	
63	185	$C_{10}H_{22}$ isomer	
64	187	p-ethyltoluene	
65A	190	1,2,4-trimethylbenzene	
65B	194	p-decane	
66	191	p-dichlorobenzene	
67	194	C_3-alkyl benzene isomer	
68	195	1,2,4-trimethylbenzene	
69	196	$C_{11}H_{24}$ isomer	
70	197	$C_{11}H_{24}$ isomer	
71	198	$C_{10}H_{20}$ isomer	
72	199	C_3-alkyl benzene isomer	
73	200	C_3-alkyl benzene isomer	
74	201	C_3-alkyl benzene isomer	
75	202	C_3-alkyl benzene isomer	
76	203	$C_{11}H_{24}$ isomer	
77	204	C_3-alkyl benzene isomer	
78	205	$C_{10}H_{18}$ isomer	
79	207	$C_{10}H_{18}$ isomer	
80	208	p-undecane	
81	209	C_3-alkyl benzene isomer	
82	211	$C_{12}H_{26}$ isomer	
83	212	C_3-alkyl benzene isomer	
84	213	C_3-alkyl benzene isomer	
85	214	C_3-alkyl benzene isomer	
86	215	C_3-alkyl benzene isomer	

(continued)

Table 84 (cont'd)

Chromatogram Peak No.	Retention Time (min)	Compound	ng/m³	Chromatogram Peak No.	Retention Time (min)	Compound	ng/m³
87	217	C_3-alkyl benzene isomer					
88	219	$C_{10}H_{12}$ isomer (cont.)					
89	220	C_3-alkyl benzene isomer					
90	225	p-dichlorobenzene					
91	229	$C_{10}H_{12}$ isomer					
92	233	C_3-alkyl benzene isomer					
93	238	p-trichlorobenzene					

[a]Ambient air sampling was at location No. 9, see Table 13 for protocol.

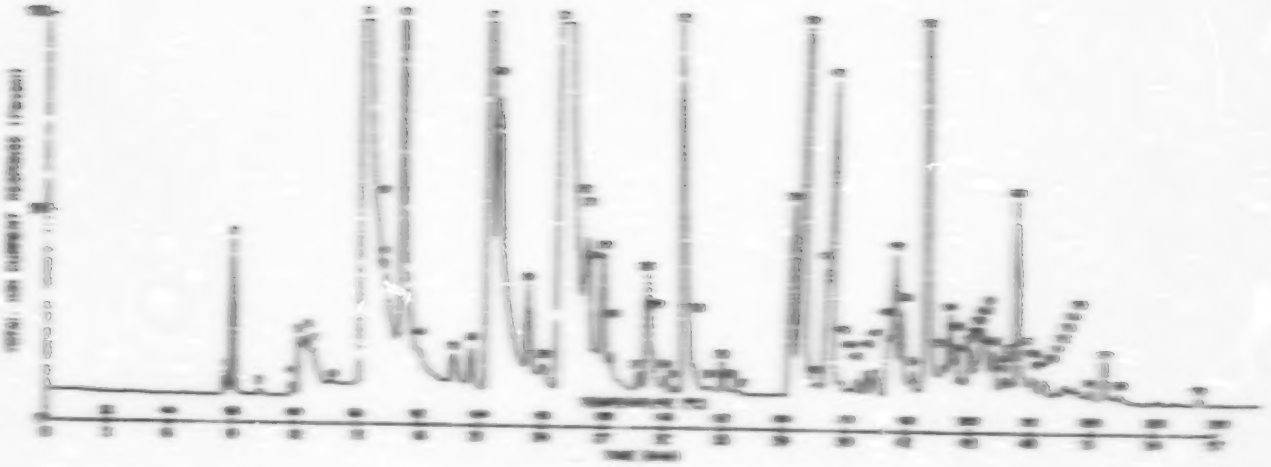

Figure 13. Total ion current profile of ambient air taken at Interstate 80 and SR 25 in Hiram, OH. See Table 13 and 25 for protocol and findings, respectively.

Table 25. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM NITRO, WV[a]

Chromatographic profile: organic peak no.	Kovats index	Compound	ng/m³
1	35	H_2	
2	36	CO_2	
3	37	SO_2	
3C	54	chloromethane	
4D	55	propyne	
5A	58	vinyl chloride	50,000
5B	60	2-methylpropene	
5	68	acetaldehyde	
6	70	n-butane	
7	74	1-butene	
8	75	C_5H_{10} isomer	
9	79	isopentane	
9C	82	acetone	125,000
10	84	C_5H_{12} isomer	
11	85	diethyl ether	
12	86	propanal	
13	89	methylene chloride	75,000
14	92	carbon disulphide	
17A	100	C_6H_{14} isomer	
16	103	3-methylpentane	
17	106	n-hexane	
18A	108	chloroform	30,000
18B	111	ethyl acetate	
19	113	C_6H_{12} isomer	
20	116	1,1,1-trichloroethane	
21A	120	benzene	150,000
21B	121	cyclohexane	
22	124	C_7H_{16} isomer	
23	125	C_7H_{16} isomer	
24	127	C_7H_{16} isomer	
25A	128	C_7H_{16} isomer	
25B	130	trichloroethylene	
26	139	n-heptane	
27	135	C_8H_{18} isomer	
28	137	C_7H_{14} isomer	
29	138	C_7H_{14} isomer	
30	140	C_8H_{18} isomer	
31	142	C_8H_{18} isomer	
32	144	toluene	
33	146	C_8H_{18} isomer	
34	149	C_8H_{18} isomer	
35	151	C_8H_{18} isomer	
36	153	C_8H_{16} isomer	
37A	155	tetrachloroethylene	
37B	160	chlorobenzene	
38	165	ethylbenzene	

Chromatographic profile: organic peak no.	Kovats index	Compound	ng/m³
39	167	p-xylene	
40	170	C_9H_{18} isomer	
41	172	m-xylene	
42	173	n-nonane	
43	177	anisole	
44	178	$C_{10}H_{22}$ isomer	
45	179	cumene	
46	180	$C_{10}H_{22}$ isomer	
47A	181	C_9H_{18} isomer	
47B	181	$C_{10}H_{20}$ isomer	
48A	181	C_9H_{18} isomer	
48B	184	benzaldehyde	
49A	185	C_3-alkyl benzene isomer	
49B	185	$C_{10}H_{22}$ isomer	
50	187	C_3-alkyl benzene isomer	
51	189	C_3-alkyl benzene isomer	
52A	192	C_3-alkyl benzene isomer	
52B	192	n-decane	
53	195	m-dichlorobenzene	
54	196	C_4-alkyl benzene isomer	
55	197	C_3-alkyl benzene isomer	
56	198	$C_{11}H_{24}$ isomer	
57	200	p-dichlorobenzene	
58	200	$C_{10}H_{20}$ isomer	
59	202	C_4-alkyl benzene isomer	
60	203	C_4-alkyl benzene isomer	
61	204	C_4-alkyl benzene isomer	
62	205	$C_{11}H_{24}$ isomer	
63	207	C_4-alkyl benzene isomer	
64	207	C_4-alkyl benzene isomer	
65	208	C_4-alkyl benzene isomer	
66	209	n-undecane	
67	211	C_5-alkyl benzene isomer	
68	212	C_5-alkyl benzene isomer	
69	213	C_5-alkyl benzene isomer	
70	215	C_5-alkyl benzene isomer	
71	217	C_5-alkyl benzene isomer	
72	218	C_5-alkyl benzene isomer	
73	220	$C_{12}H_{26}$ isomer	
74	isothermal	$C_{10}H_{12}$ isomer	
75		$C_{12}H_{26}$ isomer	
76		1,2,3,4-tetrahydronaphthalene	
77A		n-dodecane	
77B		naphthalene	
78		$C_{13}H_{28}$ isomer	
79		n-tridecane	

[a]Ambient air sampling was at location No. 15, see Table 13 for protocol.

Table 26. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR NEAR KIN-BUC CHEMICAL DISPOSAL SITE, EAST BRUNSWICK, NEW JERSEY[a]

Chromato-graphic Peak No.	Elution Time (min)	Compound	µg/m³
	59	CO_2	
1	65-6	difluorodichloromethane	
2	68	n-propane	
3	72	i-butene	
3A	73	n-butene	
4	78-81	acetaldehyde	210
5	84	isopentane	
6	85	trichlorofluoromethane	
7	89	n-pentene	
7A	90	C_5H_{10} isomer	
8	91	dichloromethane	121
9	95	C_6H_{14} isomer	
10	104	2-methylpentane	
10A	105	3-methylpentane	
11	107	C_6H_{12} isomer	
	108-110	diethyl ether	
12	108-111	perfluorobenzene (sd)	
12A	110	n-hexene	
	108-120	ethanol	
13	112-113	chloroform	
14	115-116	perfluorotoluene (sd)	
	119	methylcyclopentane	
15	120	C_5H_{10} isomer	
16	121	1,1,1-trichloroethane	
17	124-5	benzene	200
17A	125	CCl_4	30
17B	126	cyclohexane	
18	128	C_7H_{16} isomer	
18A	129	ethyl acetate (tent.)	
19B	130	C_7H_{14} isomer	
19	132	C_7H_{16} isomer and trichloro-ethylene	9
20	133	n-heptane	
21	135	C_7H_{10} isomer	
22	138	C_8H_{18} isomer	
23	140	methylcyclohexane	
24	141	C_8H_{16} isomer	
25	143	C_8H_{16} isomer	
26	148	toluene	
27	150	C_8H_{16} isomer	
28	151	C_8H_{16} isomer	
28A	153	methyl isobutyl ketone	
29	154	n-octane	
30	156-7	hexachlorocyclopentadiene	
30A	157-8	tetrachloroethylene	
31	158	C_9H_{20} isomer	
32	164	chlorobenzene	
33	167-8	ethylbenzene	
34	168-9	p-xylene	
35	172-3	styrene	
36	173-5	m-xylene and o-xylene	
36A	177	$C_{10}H_{22}$ isomer	
37	179	isopropylbenzene	
38	181	$C_{10}H_{22}$ isomer	
39	183	n-propylbenzene	
40	186	p-ethyltoluene	
40A	187	$C_{10}H_{22}$ isomer	
41	188-192	benzaldehyde and phenol	9
42	189	ethene compound	
	190	p-ethyltoluene	
42A	191	$C_{11}H_{24}$ isomer	
43	191	1-decene	
44	192-3	n-decane and 1,2,4-trimethyl-benzene	
45	196	$C_{11}H_{24}$ isomer	
46	198	C_4-alkyl benzene isomer	
47	201	$C_{11}H_{24}$ isomer	
	203	C_4-alkyl benzene isomer	
48	206-8	acetophenone	
49	210	n-undecane	
50	217	C_4-alkyl benzene isomer	
51	219	ethene compound	
54	221	ethyl phenol isomer	
55	225	n-dodecane	
56	227	naphthalene	
57	230	methyl ethyl phenol isomer	
58	232	4-isopropylphenol	
59	235	C_4-alkyl phenol isomer	
60	236	methyl-1,2-dihydronaphthalene isomer	
61	239	$C_{13}H_{28}$ isomer	
62	240	n-tridecane	
62A	240	C_4-alkyl phenol	
63	245	2-methylnaphthalene	
64	248	1-methylnaphthalene	
67	250	n-tetradecane and biphenyl	
68	252	ethylnaphthalene isomer	9
69	260	dimethylnaphthalene isomer	
70	260	dimethylnaphthalene isomer	100
71	260	dimethylnaphthalene isomer	
72	260	dimethylnaphthalene isomer	
73	260	n-pentadecane	

(continued)

Table 26 (cont'd)

Chromatographic peak No.	Station type (TC)	Compound	µg/m³	Chromatographic peak No.	Station type (TC)	Compound	µg/m³
75	2[a]	Triphenylstibine (cont.)					

[a]Ambient air was sampled during period No. 2, location No. 2, see Table 15 for protocol.

Table 27. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR NEAR KIN-BUC DISPOSAL SITE[a]

Chromato-graphic Peak No.	Elution Temp. (°C)	Compound	µg/m³
1	34	difluorodichloromethane	
2	37	1-butene	
2A	38	n-butane	
3	38-42	acetaldehyde	
3A	41	isopentane	
4	44	trichlorofluoromethane	
5A	48	furan (tent.) and C_5H_{10} isomer	
6	49	n-pentene	
7	50	propanol (tent.)	
8	54	dichloromethane	0.01
8A	57	C_5H_{12} isomer and methyl dioxiane	
9	100	C_5H_{12} isomer	
10	104	2-methylpentane	
11	108	3-methylpentane	
12	110	hexafluorobenzene and n-hexene	
13	111	chloroform	10
13A	114	diethyl ether	
14	116	perfluorotoluene (eB)	
15	121	1,1,1-trichloroethane	0.01
16	123	benzene and carbon tetra-chloride	
17	126	C_7H_{16} isomer and cyclohexane	
18	128	2-methylhexane	
18A	130	ethyl acetate (tent.)	trace
19	131	C_7H_{16} isomer	
20	133	trichloroethylene and n-heptane	
21	140	methyl cyclohexane	
22	144	C_8H_{16} isomer	
23	145	C_8H_{16} isomer	
24	148	toluene	
25	150	C_8H_{16} isomer	
26	152	C_8H_{16} isomer and n-butyl acetate (tent.)	
26A	153	2-hexanone	
27	155	n-octane	
28	156-7	hexamethylcyclotrisiloxane and trans tetrachloro-ethylene	trace
28A	159	C_9H_{18} isomer	
28B	161	C_9H_{20} isomer	
28C	163	C_9H_{18} isomer	
29	165	chlorobenzene	
30	168	ethylbenzene	
31	169	p-xylene	
32	170	C_9H_{18} isomer	
33	173	cyclooctatetraene or styrene	
34	174	p-xylene and n-nonane	
35	177	silane compound	
36	180	isopropylbenzene	
37	181	$C_{10}H_{12}$ isomer	
38	183	C_3-alkyl cyclohexane isomer	
39	186	n-propylbenzene	
40	187	m-ethyltoluene	
41	189	benzaldehyde and phenol and silane compound	
42	193-3	1,2,4-trimethylbenzene and n-decane	
43	194	$C_{11}H_{24}$ isomer	
44	196	dichlorobenzene (m or p)	
45	198	1,2,3-trimethylbenzene	
46	201	p-dichlorobenzene	
46A	202	$C_{11}H_{22}$ isomer	
47	203	C_4-alkyl benzene isomer	
48	205	$C_{11}H_{24}$ isomer	
49	208	acetophenone	
50	210	n-undecane	
51	11	$C_{10}H_{20}$ isomer	
52	215	C_4-alkyl benzene isomer	
53	217	silane compound	
54	219	$C_{10}H_{24}$ isomer	
55	221	$C_{10}H_{20}$ isomer	
55A	224	$C_{10}H_{22}$ isomer	
56	226	n-decanone	
57	228	naphthalene	
57A	229	$C_{11}H_{10}$ isomer	
58	230	dimethyl sulfide (tent.)	
59	234	$C_{12}H_{26}$ isomer	
60	237	C_5-alkyl benzene isomer	
61	240	$C_{12}H_{26}$ isomer	
62	240	n-tridecane	
64	240	2-methylnaphthalene	
65	240	1-methylnaphthalene	
67	240	$C_{14}H_{30}$ isomer	
68	240	n-tetradecane and biphenyl	
69	240	ethylnaphthalene isomer	
70	240	dimethylnaphthalene isomer	
71	240	dimethylnaphthalene isomer	
72	240	dimethylnaphthalene isomer	
73	240	biphenylene	
74	240	n-pentadecane	

[a]Ambient air was sampled during period No. 4, location 2, see Table 15 for protocol.

Table 28. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR NEAR KIN-BUC DISPOSAL SITE[a]

Chromatographic Peak No.	Elution Temp. (°C)	Compound	µg/m³
1	66	dichlorodifluoromethane	
2	73	1-butene	
3	75	n-butane	
4	81	acetaldehyde	
5	84	isopentane	
6	87	trichlorofluoromethane	
7	89	n-pentane and furan	
8	96	dichloromethane	0.01
10	104	2-methylpentane	
11	107	3-methylpentane	
12	110	hexafluorobenzene and n-hexane	
13	113	chloroform	20
14	116	perfluorotoluene (?)	
15	121	1,1,1-trichloroethane	0.03
16	125	benzene	0.90
16A	126	cyclohexane and C_7H_{14} isomer	
17	128	2-methylhexane	
18	131	C_7H_{14} isomer	
19	132	n-heptane	
19A	133	C_8H_{10} isomer	
20	140	methylcyclohexane	
20A	143	n-propyl acetate (tent.)	trace
21	147	toluene	
21A	148	C_8H_{18} isomer	
21B	151	C_8H_{16} isomer	
22	153	n-octane	
23	155	hexamethylcyclotrisiloxane and tetrachloroethylene	
24	160	C_9H_{20} isomer	
25	165	chlorobenzene	
26	166	ethylbenzene	
27	167	p-xylene	
28	169	C_9H_{18} isomer	
29	171	styrene	
30	172	o-xylene and n-nonane	
31	175	$C_{10}H_{22}$ isomer	
32	178	isopropylbenzene	
33	181	$C_{10}H_{22}$ isomer and C_3-alkyl cyclohexane	
34	184	n-propylbenzene	
35	185	m-ethyltoluene	
36	186	benzaldehyde	
37	187	cresol compound	
38	188	phenol	.6
39	190	1,2,4-trimethylbenzene and n-decane	

Chromatographic Peak No.	Elution Temp. (°C)	Compound	µg/m³
40	191	p or m-dichlorobenzene and ter-butylbenzene	
41	195	1,2,3-trimethylbenzene	
42	199	methyl styrene isomer and sec-butylbenzene	
43	200	p-cymene	
44	201	n-butylbenzene	
45	201	$C_{11}H_{24}$ isomer	
46	203	p-propyltoluene	
47	203-5	acetophenone and C_4-alkyl benzene isomer	
48	206	methyl indan isomer	
49	207	n-undecane	
50	208	C_4-alkyl benzene isomer	
50A	209	$C_{12}H_{26}$ isomer	
51	210	C_4-alkyl benzene isomer	
52	212	C_5-alkyl benzene isomer	
53	213	C_5-alkyl benzene isomer	
53A	216	C_5-alkyl cyclohexane isomer	
54	217	methyl indan isomer	
54A	217	$C_{12}H_{24}$ isomer	
55	219	C_5-alkyl benzene isomer and C_4-alkyl benzene isomer	
56	221	$C_{12}H_{24}$ isomer and C_5-alkyl benzene isomer	
56A	222	C_5-alkyl benzene	
57	225	n-dodecane	
57A	225	dimethyl indan isomer	
58	226	naphthalene	
59	229	C_5-alkyl benzene and $C_{13}H_{28}$ isomer	
59A	230	C_6-alkyl benzene isomer	
60	232	$C_{13}H_{26}$ isomer	
61	234	$C_{13}H_{26}$ isomer and C_5-alkyl indan isomer	
61A	235	$C_{14}H_{16}$ isomer	
62	237	$C_{13}H_{26}$ isomer	
63	240	$C_{13}H_{26}$ isomer	
63A	240	C_5-alkyl indan isomer	
64	240	n-tridecane	
65	246	2-methylnaphthalene	
67	250	1-methylnaphthalene	
69	260	$C_{14}H_{30}$ isomer	
70	260	n-tetradecane	

[a]Ambient air was sampled during period No. 3, location No. 2, see Table 15 for protocol.

Table 39. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR NEAR KIN-BUC DISPOSAL SITE[a]

Chromato-graphic Peak No.	Elution time (s)	Compound	µg/m³
1	68	dichlorodifluoromethane	
2	72	CO_2	
2A	75	propane	
3	76	i-butane	
3A	77	n-butane	
4	80-6	acetaldehyde	
5	88	isopentane	
6	90	trichlorofluoromethane	
7	92	C_5H_{10} isomer	
8	93	n-pentane	
8A	96	C_6H_{12} isomer	
9	98	dichloromethane	trace
	99	C_6H_{14} isomer	
10	100-1	3-methylpentane	
11	108	2-methylpentane	
12	111	C_6H_{12} isomer	
13	113	perfluorobenzene (e8)	
14	114	n-hexane	
15	116-7	chloroform	45
16	120	perfluorotoluene (e8)	
	122	C_6H_{12} isomer	
17	126-8	1,1,1-trichloroethane	trace
18	128	benzene	15
18A	129	CCl_4	trace
19	130	cyclohexane and C_7H_{16} isomer	
	131	C_7H_{16} isomer	
20	133	C_7H_{14} isomer	
21A	136	C_7H_{14} isomer	
21	145	trichloroethylene	11
22	137	n-heptane	
23	142	C_8H_{16} isomer	
24	144	methylcyclohexane	
25	147	C_8H_{12} isomer	
26	150	C_8H_{16} isomer	
27	150-4	toluene	971
28	156	1-octene	
29	158	n-octane	
30	160	hexamethylcyclotrisiloxane	
31	161	tetrachloroethylene	
31A	166	acetal ethyl cyclopentane isomer	
32	168	chlorobenzene	
33	170	ethylbenzene	
34	172	p-xylene	
35	174	C_8H_{16} isomer	
36	176	styrene or cyclooctatetraene	
37	177	o-xylene and n-nonane	
38	182	$C_{10}H_{22}$ isomer	
39	185	isopropylbenzene	
40	185	n-propylbenzene	
41	188	p-chlorotoluene	41
42	189	p-ethyltoluene	
43	190	benzaldehyde	
44	191	phenol	
45	193	p-ethyltoluene	
46	194-6	benzyl methyl ether	
47	198	benzyl chloride	
48	206	C_9-alkyl benzene	
49	209	2,3-dihydrobenzaldehyde or benzyl chloride	
50	210	acetophenone and C_9-alkyl benzene and $C_{10}H_{20}$ isomer	
51	212	n-undecane and methyl benzoate	
52	217	dichlorotoluene isomer	
53	218	silane compound	
	223	dichlorotoluene isomer	
54	227	n-dodecane	
57	229	naphthalene	
58	231-3	methyl toluate isomer	
	240	methylnaphthalene isomer	

[a]Ambient air was sampled during period no. 4, location no. 5, see Table 15 for protocol.

Table 30. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR NEAR KIN-BUC DISPOSAL SITE[a]

Chromatographic Peak No.	Elution Time	Compound	µg/m³
1	65	dichlorotrifluoroethane	
1A	71	i-butane	
1B	74	n-butane	
1C	75	2-butene	
2	77	SO_2	
3	80	acetaldehyde	
3A	84	isopentane	
4	86	trichlorofluoromethane	
4A	88	C_5H_{10} isomer	
5	89	n-pentane	
6	90-2	vinyl methyl ether	5,000
6A	92	bromoethane	
7	93-6	dichloromethane	1,150
7A	98	1,1,1-trifluoro-2,2,2-trichloroethane	
8	100	acetone	
9	101	diethyl ether	30
9A	102	methyl n-propyl ether	
10	104	2-methylpentane	
11	105-8	vinyl isopropyl ether and C_6H_{14} isomer	15,000 (either)
12	109	perfluorobenzene (sd)	
13	110-11	n-hexane	
14	112-115	chloroform and diisopropyl ether	765 ($CHCl_3$) 4130 (ether)
15	116	perfluorotoluene (sd)	
15A	117	methyl ethyl ketone	
15B	117	C_6H_{12} isomer	
16	118	ethyl acetate	
17	119	1,2-dichloroethane	37
18	120	1,1,1-trichloroethane	600
19	125	benzene	600
20	126	cyclohexane and C_7H_{16} isomer	
21	128	3-methylhexane	
21A	129	isopropyl acetate	
21B	130	C_7H_{16} isomer	
22	131	dibromomethane	61
22A	132	trichloroethylene	
23	133	n-heptane	
24	134-6	ethyl acrylate	
25	137-8	1-chloro-2-bromoethane	37
25A	139	methyl methacrylate	
26	140	methyl cyclohexane and n-propyl acetate	
27	141-4	4-methyl-2-pentanone	660
27A	145-6	1,1,2-trichloroethane	
28	147-50	toluene	33
29	151	dimethylcyclohexane	
30	154	n-octane	
30A	155	hexamethylcyclotrisiloxane	
31	157	tetrachloroethylene	142
32	160	n-butyl acetate	
33	161	methylethylcyclopentane isomer	
34	164	chlorobenzene	
35	167	ethylbenzene	
36	168-9	p-xylene	
37	171	C_9H_{20} isomer	
38	173	styrene	
39	174	o-xylene and n-nonane	
	177	$C_{10}H_{22}$ isomer	
	178	$C_{10}H_{20}$ isomer	
40	179	$C_{10}H_{22}$ isomer	
41	180	isopropylbenzene	
42	181	$C_{10}H_{12}$ isomer	
43	183	n-propylcyclohexane	
43A	184	$C_{10}H_{12}$ isomer	
43B	185	$C_{10}H_{20}$ isomer	
44	186	n-propylbenzene	
45	187-8	p-ethyltoluene and trimethylheptane isomer	
46	189	$C_{10}H_{22}$ isomer and p-ethyltoluene	
47	190	$C_{10}H_{22}$ isomer	
47A	191	$C_{10}H_{20}$ isomer	
48	192	n-decane and 1,3,5-trimethylbenzene	
48A	193	$C_{11}H_{24}$ isomer	
49	197	$C_{11}H_{24}$ isomer and C_3-alkyl benzene	
50	198	1,2,3-trimethylbenzene and $C_{11}H_{24}$ isomer	
51	202	$C_{11}H_{24}$ isomer	
52	208	$C_{12}H_{26}$ isomer	
53	208	C_4-alkyl benzene isomer and acetophenone	
54	210	$C_{12}H_{26}$ isomer	
	240	naphthalene	

[a]Ambient air was sampled during period no. 4, location on the mound, see Table 13 for protocol.

Table 31. VOLATILE ORGANIC VAPORS IN AMBIENT AIR NEAR KIN-BUC DISPOSAL SITE[a]

Chromatographic peak No.	Elution time	Compound	ppb[b]
	59	CH_4	
	60	cyclopropane	
1	61	dichlorodifluoromethane	
2	62	propane	
2A	73	i-butane	
3	74	n-butane	
3A	75	2-butene	
4B	77	chloromethane	
4	80	acetaldehyde	
5A	81	dichlorofluoromethane	
5B	83	acetone (tent.)	
6	85	isopentane	
7	86	trichlorofluoromethane	
7A	89	C_5H_{10} isomer	
8	90	n-pentane	
8A	92	C_5H_{10} isomer	
9	95	dichloromethane	15
10	97	2,3-dimethylbutane	
11	100	C_6H_{14} isomer	
12	104	2-methylpentane	
13	107	dimethyl ether	
14	108	3-methylpentane	
14A	109	C_6H_{12} isomer	
15	110	hexafluorobenzene (e8)	
16	111	n-hexane	
16A	113	diethyl ether	35
17	115	chloroform	
18	117	perfluorotoluene (e8)	
19	119	C_7H_{14} isomer	
19A	120	C_7H_{14} isomer	
20	121	1,1,1-trichloroethane	0.06
21	125	benzene	
21A	126	carbon tetrachloride	trace
22	127	cyclohexane and C_7H_{14} isomer	
23	129	C_7H_{14} isomer	
24	131	C_7H_{14} isomer	
25	132	1-heptene	
26	134	tetrachloroethylene and n-heptane	
27	139	C_8H_{16} isomer	
28	141	methylcyclohexane	
28A	142	C_8H_{16} isomer	
29	144	C_8H_{16} isomer	
30	146	C_8H_{16} isomer	
31	148	toluene	
31A	150	C_8H_{16} isomer	
32	152	C_8H_{16} isomer and 2-methyl-2-pentanone	
33	154	n-octane	
34	157	hexamethylcyclotrisiloxane	
35	158	tetrachloroethylene	8
36	161	C_8H_{20} isomer	
36A	162	C_8H_{16} isomer	
37	165	chlorobenzene	trace
38	166	ethylbenzene	
39	169	p-xylene	
39A	171	C_8H_{16} isomer	
40	173	cyclooctatetraene or styrene	
41	17	m-xylene and n-nonane	
41A	176	$C_{10}H_{22}$ isomer	
42	180	isopropylbenzene	
42A	181	$C_{10}H_{22}$ isomer	
43	183	C_3-alkyl cyclohexane isomer	
	184	$C_{10}H_{22}$ isomer	
44	186	n-propylbenzene	
45	187	m-ethyltoluene and $C_{11}H_{24}$ isomer	
46	188	benzaldehyde	
47	190	phenol	.10
47A	191	silane compound	
47B	192	1-decene	
48	193	1,3,5-trimethylbenzene and n-decene	
49	196	o or p-dichlorobenzene	
49A	197	C_3-alkyl benzene isomer and $C_{11}H_{24}$ isomer	
50	198	1,2,3-trimethylbenzene	
50A	199	$C_{11}H_{24}$ isomer	
50B	200	p-dichlorobenzene	
51	201	methyl styrene	
51A	202	C_3-alkyl benzene isomer	
52	204	$C_{11}H_{24}$ isomer	
53	206	acetophenone	
54	210	n-undecene	
54A	211	$C_{10}H_{18}$ isomer	
55	212	$C_{11}H_{24}$ isomer and $C_{12}H_{26}$ isomer	
55A	213	$C_{11}H_{20}$ isomer	
57	215	C_4-alkyl benzene	
58	217	silane compound	
60	221	C_4-alkyl benzene isomer and C_5-alkyl benzene isomer	

(continued)

Table 41 (cont'd)

Chromatogram Station				Chromatogram Station			
Graph Peak No.	Type[a]	Component	µg/m³	Graph Peak No.	Type[a]	Component	µg/m³
64	151	i-undecane					
65	150	n-undecane					
66	154	naphthalene					
67	150	i-tridecane					
68	150	n-tridecane					
69	150	2-methylnaphthalene					
70	150	1-methylnaphthalene					
72	150	biphenyl					
73	150	n-tetradecane					
74	150	ethylnaphthalene isomer					
75	150	dimethylnaphthalene isomer					
76	150	dimethylnaphthalene isomer	.30				
77	150	dimethylnaphthalene isomer					
78	150	biphenylene					

[a]Ambient air sampled during period no. 5, location no. 3, see Table 15 for protocol.

Table 32. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR NEAR KIN-BUC DISPOSAL SITE[a]

Chromatographic fraction graph: Peak no.	Temp. (°C)	Compound	µg/m³
1		difluorodichloromethane	
2		acetaldehyde	
3A	41	isopentane	
4	45	trichlorofluoromethane	
5	48	n-pentane	
5A	51	C_5H_{10} isomer	
6B	52	bromoethane	1
7	61-1	dichloromethane	1/3
8	101-1	2-methylpentane	
9	103-108	3-methylpentane and diethyl ether	11
10	108-110	p-trifluorobenzene and n-hexane	
11	111	$CHCl_3$	74
12	113	diisopropyl ether	17
13	114-1	perfluorotoluene (e8)	
14	116	methylcyclopentane and n-butanol	30
15	118	ethyl acetate and 1,2-dichloroethane	20 + 35
16	119	1,1,1-trichloroethane	21
17	122-4	benzene	1,550
18	125	2,3-dimethylpentane	
19	126-8	isopropyl acetate and C_7H_{16} isomer	
20	128-1	trichloroethylene and C_7H_{14} isomer and n-heptane	
21	133-4	2,5-dimethylfuran (tent.) and methyl methacrylate	
22	135-6	1-chloro-2-bromoethane	23
23	137	C_7H_{14} isomer	
24	139-145	4-methyl-2-pentanone	811
24A	144	1,1,2-trichloroethane	17
25	145-50	toluene	5,300
26	151	C_8H_{16} isomer	
27	152-6	n-octane	15,000
27A	155-8	tetrachloroethylene	
28	159	C_9H_{20} isomer	
29	160-1	C_8H_{16} isomer	
30	164-5	chlorobenzene	90
30A	165-7	ethylbenzene	
31	167-70	C_8H_{10} isomer and p-xylene	
32A	171-2	styrene	
32	173-5	p-xylene and p-xylene and C_8H_{10} isomer	
33	177	$C_{10}H_{22}$ isomer	
34	178-9	isopropylbenzene	

Chromatographic fraction graph: Peak no.	Temp. (°C)	Compound	µg/m³
35	179-80	$C_{10}H_{22}$ isomer	
36	181-2	propylcyclohexane and $C_{10}H_{20}$ isomer	
37	183-9	n-propylbenzene and chlorotoluene and p-ethyltoluene and $C_{10}H_{12}$ isomer	29,700
38A	186-9	$C_{10}H_{20}$ isomer and ether compound	
38B	188-89	p-ethyltoluene and α-methyl styrene	
	190	$C_{10}H_{20}$ isomer	
39	190-93	n-decane and 1,3,5-trimethylbenzene	
37A	194	p-dichlorobenzene	
37	195-196	$C_{11}H_{24}$ isomer and C_4-alkyl benzene	
37A	196-7	1,2,3-trimethylbenzene	
37B	197-8	$C_{10}H_{18}$ isomer	
37C	198-200	p-dichlorobenzene	
	198-200	C_4-alkyl cyclohexane isomer and α-methylstyrene and C_4-alkyl benzene and $C_{11}H_{22}$ isomer	49,000
37D	200-2	$C_{11}H_{24}$ isomer	
37E	202-4	C_4-alkyl benzene isomer and $C_{11}H_{24}$ isomer	
		C_4-alkyl benzene	
38A	205-6	$C_{10}H_{18}$ isomer	
	205-8	acetophenone	12,860
38B	206	$C_{10}H_{18}$ isomer and $C_{11}H_{24}$ isomer and C_4-alkyl benzene	
38	207-14	n-undecane	
38C	209-10	C_5-alkyl benzene isomer	
38D	211	C_5-alkyl cyclohexane isomer and C_5-alkyl benzene isomer and $C_{10}H_{16}$ isomer	
39	212-14	C_5-alkyl benzene isomer	
40	213	C_5-alkyl benzene isomer and $C_{11}H_{20}$ isomer	
41	216-7	C_5-alkyl benzene isomer	
42	218-19	C_5-alkyl benzene isomer	
43	220-22	C_5-alkyl benzene isomer and $C_{10}H_{16}$ isomer	
44	222-24	1,2,3-trichlorobenzene and n-dodecane	
45	223	naphthalene	

(continued)

Table 32 (cont'd)

Chromatogram Fraction Aliphatic Peak No.	Type	Compound	ng/m³	Chromatogram Fraction Aromatic Peak No.	Type	Compound	ng/m³
48	229	$C_{14}H_{28}$ isomer and $C_{13}H_{14}$ isomer					
47	230	1,2,4-trichlorobenzene					
48	232	$C_{13}H_{26}$ isomer					
49	235	$C_{13}H_{24}$ isomer					
50	237	trideiane					
51	239	n-tridecene					
	240	$C_{12}H_{16}$ isomer					
52	240	β-methylnaphthalene	1,100				
53		α-methylnaphthalene	1,000				
54		C_2-alkyl benzene isomer					
55		$C_{13}H_{16}$ isomer					
56		$C_{14}H_{28}$ isomer					
57		n-tetradecene					
58		$C_{13}H_{26}$ isomer					
59		$C_{13}H_{18}$ isomer					
60		β-ethylnaphthalene					
61		α-ethylnaphthalene and $C_{13}H_{30}$ isomer					

[a]Ambient air sampled during period No. 1, location No. 1, see Table 15 for protocol.

Table 33. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR NEAR KIN-BUC DISPOSAL SITE[a]

Chromatographic Peak No.	Elution Temp. (°C)	Compound	µg/m³
1	34	dichlorodifluoromethane	
2	39	n-propane	
3	71	i-butane	
4	73	n-butane	
5	81	acetaldehyde	
7	85	isopentane	
8	88	trichlorofluoromethane	
8A	90	furan	
8B	91	C_8H_{18} isomer	
8C	92	n-pentane	
9	96	C_9H_{10} isomer	
10	100	dichloromethane	0.01
11	103	3-methylpentane	
12	130	3-methylpentane	
13A	190	1-hexene	
13	111	hexafluorobenzene and n-hexane	
14	113	trichloromethane ($CHCl_3$)	10
15	117	perfluorotoluene (a	
15A	120	methylcyclohexane	
15B	120	C_7H_{14} isomer	
16	122	1,1,1-trichloroethane	0.03
17	125	benzene	10
17A	126	carbon tetrachloride	trace
18	127	2-methylhexane	
18B	128	C_7H_{14} isomer	
19	132	3-methylhexane	
20	133	trichloroethylene	
21	135	n-heptane	
23	140-1	n-propylbenzene	
23A	140	C_8H_{10} isomer	
24	148	toluene	150
25	150	4-methyl-2-pentanone	
25A	153	C_8H_{16} isomer	
26	155	n-octane	
28	157	hexamethylcyclotrisiloxane	
27	159	tetrachloroethylene	60
28	161	C_9H_{20} isomer	
29	163	dimethylheptane isomer	
30	160	chlorobenzene	4
31	168	ethylbenzene	
32	169	p-xylene	
33	173	styrene	
34	179	o-xylene and n-nonane	
35A	176	1,1,2,2-tetrachloroethane	9
33	178	$C_{10}H_{20}$ isomer	
36	180	isopropylbenzene	
37	181	$C_{10}H_{22}$ isomer	
38	183	$C_{10}H_{20}$ isomer	
39	185	n-propylbenzene	
40	186	m-ethyltoluene and $C_{10}H_{22}$ isomer	
41	188	benzaldehyde	10
41A	189	ethene compound (BHC)	
42	189-90	phenol and p-ethyltoluene	
43	193	1,3,5-trimethylbenzene and n-decane	
43A	191	$C_{11}H_{24}$ isomer	
44	194	C_9-alkyl benzene isomer	
45	197	1,2,4-trimethylbenzene and $C_{11}H_{24}$ isomer	
46	198	$C_{11}H_{22}$ isomer	
47	201	dichlorobenzene (o or p)	
48	203	$C_{11}H_{24}$ isomer	
49	205	C_9-alkyl benzene isomer	
50	206	acetophenone	
50A	208	C_9-alkyl benzene isomer	
51	209	$C_{10}H_{14}$ isomer and $C_{11}H_{24}$ isomer	
52	211	C_9-alkyl benzene isomer	
53	215	C_9-alkyl benzene isomer	
54	217	C_9-alkyl cyclohexane isomer	
54A		ethene compound (BBB)	
55	219	$C_{10}H_{22}$ isomer	
56	221	C_9-alkyl benzene isomer	
56A	223	C_9-alkyl benzene isomer	
57	225	1,2,3-trimethyl[illegible] zene	
58	227	naphthalene	
60	231	$C_{11}H_{20}$ isomer	
61	240	C_9-alkyl benzene isomer	
62		2-methylnaphthalene	
62A		1-methylnaphthalene	trace
62B		$C_{12}H_{26}$ isomer	
63		n-tetradecane	
64		biphenyl	

[a]Ambient air sampled during period no. 5, location no. 4, see Table 15 for protocol.

Table 34. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM LOS ANGELES, CA[a]

Chromatographic Peak No.	Elution Time (hr)	Compound	µg/m³
2	37	CO_2	
3	40	propylene	
4	41	dichlorodifluoromethane	
5	42	chloromethane	
6	43	n-propane	
7	45	i-butane	
8	46	n-butane	
10	49	2-butene	
10A	50	chloroethane	
11	51	acetaldehyde	
13	53	isopentane	
14	56	trichlorofluoromethane	
15	58	C_5H_{10} isomer and furan	
16	59	n-pentane	
17	61	C_5H_{10} isomer	
19	64	dichloromethane	
21	66	propanal	
23	70	C_6H_{10} isomer	
23A	71	C_6H_{12} isomer	
24	72	2-methylpentane	
24A	73	acetone (cont.)	
25	75	3-methylpentane	
26	77	4-methyl-1-pentene	
26A	78	hexafluorobenzene (sd)	
27	80	n-hexane and 2-methylfuran	
28	81	chloroform	
28A	82	3-methylfuran (cont.)	
29	83	C_6H_8O isomer	
29A	84	C_6H_{12} isomer	
30	85	perfluorotoluene (sd)	
31	87	methyl cyclopentane and C_7H_{16} isomer	
32	90	1,1,1-trichloroethane	
32A	91	C_7H_{14} isomer and C_6H_{12} isomer	
33	92	methyl ethyl ketone	
34	93	benzene and carbon tetrachloride	
35	95	cyclohexane	
36	96	2-methylhexane	
37	97	C_7H_{16} isomer	
37A	97	C_7H_{14} isomer	
38	98	3-methylhexane	
39	101	1,3-dimethylcyclopentane isomer	
40	103	trichloroethylene and methyl butanol isomer (cont.)	
41	104	n-heptane	
41A	106	2,5-dimethylfuran	
42	107	2-pentanone	
43	109	2,2-dimethylhexane	
44	111	methylcyclohexane	
45	113	C_8H_{16} isomer	
46	114	C_7H_{14} isomer and C_8H_{16} isomer	
47	115	4-methyl-2-pentanone and C_8H_{16} isomer	
48	117	4-methylheptane	
49	119	toluene	
50	120	C_8H_{16} isomer	
50A	121	isobutyl acetate (cont.)	
51	122	2,4-dimethylhexane	
52	125	dimethylcyclohexane isomer	
52A	125	dimethylhexadiene isomer	
53	127	C_8H_{16} isomer	
54	128	n-octane	
55	130	tetrachloroethylene	
55A	131	n-butyl acetate	
56	135	C_8H_{20} isomer	
57	137-8	dimethylcyclohexane isomer and chlorobenzene	
58	139	C_8H_{16} isomer	
59	142	ethylbenzene	
59A	143	C_8H_{20} isomer	
60	144	p-xylene (or m)	
61	145	3-methylnonane or C_9H_{20} isomer	
61A	148	styrene	
62	149	o-xylene	
62A	150	C_9H_{18} isomer	
63	151	n-nonane	
64	152	$C_{10}H_{22}$ isomer	
66	156	isopropylbenzene	
67	159	$C_{10}H_{22}$ isomer	
68	160	C_9-alkyl cyclohexane	
68A	161	$C_{10}H_{20}$ isomer	
69	162	n-propylbenzene	
70	164	m-ethyltoluene	
71	165	$C_{10}H_{22}$ isomer	
72	165	1,3,5-trimethylbenzene	
73	166	$C_{10}H_{20}$ isomer	
74	168	p-ethyltoluene	
74A	169	o-methylstyrene	
74B	170	$C_{10}H_{20}$ isomer	
75	171	1,2,4-trimethylbenzene	

(continued)

Table 34 (cont'd)

Chromatographic fraction				Chromatographic fraction			
Graphic Peak No.	Type	Compound	ng/m³	Graphic Peak No.	Type	Compound	ng/m³
76A	171	$C_{10}H_{20}$ isomer					
76	172	n-decane					
77	173	p (or m)-dichlorobenzene					
78	176	C_4-alkyl benzene isomer					
79	177	$C_{11}H_{24}$ isomer					
80	178	$C_{11}H_{22}$ isomer					
81	180	4-methylstyrene or indan					
81A	181	C_4-alkyl aromatic isomer					
81B	181	$C_{11}H_{22}$ isomer					
82	182	sec-butylbenzene					
83	183	p-cymene and C_4-alkyl benzene isomer					
84	184	acetophenone					
85	186	C_4-alkyl benzene isomer					
86	188	C_4-alkyl benzene isomer and $C_{10}H_{14}$ isomer					
87	189	C_4-alkyl benzene isomer and methyl indan isomer					
87A	190	$C_{11}H_{24}$ isomer					
88	191	p-undecane					
90	194	C_4-alkyl benzene isomer					
91	198	$C_{11}H_{20}$ isomer					
92	204	C_4-alkyl benzene isomer					
93	210	p-dodecane and naphthalene					

[a]Ambient air was sampled at 15th and Emery St. (Fig. 10), see Table 17 for protocol; volume of air was 0.1 of sample in Table 35.

Table 35. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM LOS ANGELES, CA[a]

Chromatographic Peak No.	Elution Time (Min)	Compound	ng/m³
1	40	H_2	
2	42	O_2	
3	44	CO_2	
4	46	dichlorodifluoromethane	
5	48	butane	
6	49	butene	
7	50	butene	
8	51	chloropropane (tent.)	
9	56	acetaldehyde	133,000
10	61	isopentane	
11	63	trichlorofluoromethane	
12	64	furan	
13	65	pentane	
14	66	vinyl methyl ether	
15	67	acrolein	
16	68	ethanol	
17	70	CS_2	
18	72	Freon 113 (BCH)	
19	73	acetone	
20	75	monovinyl glycol ether (tent.)	
21	80	methylpentane	
22	81	methylpentane	
23	83	perfluorobenzene (ad)	
24	86	hexane	
25	88	chloroform	
26	89	methyl ethyl ketone	
27	92	perfluorotoluene (ad)	
28	94	methylcyclopentane	
29	95	dimethyl ethylhexane (tent.)	
30	98	1,1,1-trichloroethane	8,340
31	100	benzene	18,481
32	101	methylheptane	
33	101	CCl_4	
34	102	cyclohexane	
35	102	dimethylheptane	
36	103	C_9H_{18} isomer	
37	105	C_7H_{14} isomer	
38	107	heptanol	
39	108	C_8H_{16} isomer	
40	109	trichloroethylene	
41	110	C_9H_{18} isomer	
42	110	C_8H_{16} isomer	
43	111	C_9H_{18} isomer	
44	113	dimethylfuran	
45	114	C_8H_{14} isomer	
46	116	trimethylpentane	
47	118	dimethylpentane	
48	119	bromofluoromethane (tent.)	
49	119	C_8H_{20} isomer	
50	120	dimethylhexane	
51	120	C_9H_{14} isomer	
52	121	3-hexanone	
53	122	C_8H_{16} isomer	
54	123	C_8H_{16} isomer	
55	123	dihydropyran	
56	124	dimethylhexane	
57	126	toluene	
58	127	C_8H_{16} isomer	
59	128	C_8H_{16} isomer	
60	129	C_8H_{16} isomer	
61	130	C_8H_{16} isomer	
62	130	C_8H_{16} isomer	
63	131	C_8H_{16} isomer	
64	133	C_8H_{16} isomer	
65	134	2-propyl acetate	
66	137	C_8H_{16} isomer	
67	138	tetrachloroethylene	
68	140	C_8H_{16} isomer	
69	141	C_8H_{20} isomer	
70	142	C_8H_{18} isomer	
71	144	C_8H_{14} isomer	
72	146	chlorobenzene	
73	148	C_8H_{16} isomer	
74	149	ethylbenzene	
75	150	C_8H_{18} isomer	
76	151	dimethylbenzene	
77	151	C_8H_{20} isomer	
78	152	C_8H_{16} isomer	
79	153	C_8H_{18} isomer	
80	153	styrene	
81	154	dimethylbenzene	
82	157	C_8H_{16} isomer	
83	157	C_8H_{20} isomer	
84	160	2,4-dibromo-1-butene (tent.)	
85	163	C_8H_{16} isomer	
86	163	methyl ethylbenzene	
87	163	$C_{12}H_{26}$ isomer	
88	164	C_8H_{16} isomer	
89	165	C_8H_{18} isomer	
90	165	$C_{10}H_{22}$ isomer	
91	166	C_8H_{16} isomer	
92	166	$C_{10}H_{20}$ isomer	
93	167	C_9H_{20} isomer	

(continued)

Table 35 (cont'd)

Chromatogram Peak No.	Elution Time	Compound	ng/m³
95	168	$C_{10}H_{10}$ isomer	
96	169	benzaldehyde	
97	169	$C_{10}H_{10}$ isomer	
98	170	trimethylbenzene	
99	171	$C_{10}H_{12}$ isomer	
100	172	trimethylbenzene	
101	173	$C_{11}H_{14}$ isomer	
102	174	$C_{10}H_{10}$ isomer	
103	175	$C_{10}H_{12}$ isomer	
104	176	$C_{10}H_{10}$ isomer	
105	176	benzonitrile	
106	176	trimethylbenzene	
107	176	$C_{10}H_{10}$ isomer	
108	176	methyl cyclopropyl benzene (cont.)	
110	177	$C_{10}H_{10}$ isomer	
111	178	C_3-alkyl benzene isomer	
112	179	$C_{10}H_{12}$ isomer	
113	180	phenol	
114	181	C_3-alkyl benzene isomer	
115	182	dichlorobenzene	
116	183	C_3-alkyl benzene isomer	
117	183	$C_{11}H_{16}$ isomer	
118	184	C_3-alkyl benzene isomer	
119	185	$C_{11}H_{14}$ isomer	
120	186	$C_{10}H_{10}$ isomer	
121	187	$C_{11}H_{16}$ isomer	
122	187	dichlorobenzene	
123	187	$C_{11}H_{16}$ isomer	
124	187	$C_{11}H_{14}$ isomer	
125	188	dihydroindene	
126	188	$C_{10}H_{10}$ isomer	
127	188	$C_{11}H_{12}$ isomer	
128	189	C_3-alkyl benzene isomer	
129	190	C_3-alkyl benzene isomer	
130	190	acetophenone	
131	191	$C_{11}H_{12}$ isomer	
132	192	$C_{11}H_{14}$ isomer	
133	193	$C_{11}H_{12}$ isomer	
134	193	C_3-alkyl benzene isomer	
135	194	C_3-alkyl benzene isomer	
136	195	$C_{10}H_{10}$ isomer	
137	195	$C_{11}H_{10}$ isomer	
138	196	$C_{11}H_{12}$ isomer	
139	196	dimethylstyrene	
140	197	$C_{11}H_{14}$ isomer	
141	198	$C_{11}H_{12}$ isomer	
142	199	C_3-alkyl benzene isomer	
143	200	$C_{11}H_{12}$ isomer	
144	200	$C_{11}H_{14}$ isomer	
145	201	$C_{11}H_{14}$ isomer	
146	202	$C_{11}H_{12}$ isomer	
147	202	$C_{10}H_{10}$ isomer	
148	203	C_3-alkyl benzene isomer	
149	204	$C_{11}H_{14}$ isomer	
150	204	C_3-alkyl benzene isomer	
151	205	$C_{11}H_{10}$ isomer	
152	206	$C_{11}H_{14}$ isomer	
153	206	C_3-alkyl benzene isomer	
154	207	methylstilbene	
155	207	C_3-alkyl benzene isomer	
156	208	phenylcyclohexylethane (cont.)	
157	208	$C_{11}H_{16}$ isomer	
158	209	$C_{11}H_{10}$ isomer	
159	209	C_3-alkyl benzene	
160	210	$C_{11}H_{10}$ isomer	
161	210	ethylstyrene	
162	211	C_3-alkyl benzene isomer	
163	211	$C_{11}H_{14}$ isomer	
164	212	C_3-alkyl benzene isomer	
165	214	$C_{11}H_{12}$ isomer	
166	214	$C_{11}H_{14}$ isomer	
167	214	$C_{11}H_{10}$ isomer	
168	215	trichlorobenzene	
169	216	$C_{11}H_{10}$ isomer	
170	216	naphthalene	
171	217	C_3-alkyl benzene isomer	
172	218	$C_{11}H_{10}$ isomer	
173	220	$C_{11}H_{14}$ isomer	
174	221	C_3-alkyl benzene isomer	
175	224	C_3-alkyl benzene isomer	
176	225	C_3-alkyl phenol (cont.)	
177	226	cyclohexylphenol (cont.)	
178	230	$C_{11}H_{10}$ isomer	
179	231	$C_{11}H_{14}$ isomer	
180	231	$C_{10}H_{10}$ isomer	
181	236	methylnaphthalene	
182	240	$C_{11}H_{14}$ isomer	
183		methylnaphthalene	
184		$C_{11}H_{10}$ isomer	
185		biphenyl	
186		$C_{10}H_{10}$ isomer	

[a] Ambient air was sampled at 15th and Emery St. (Fig. 10), see Table 17 for protocol.

Table 36. VOLATILE ORGANIC VAPORS IDENTIFIED IN AMBIENT AIR FROM DOMINGUES, CA[a]

Chromatographic Flotation Organic Peak No.	Type[b]	Compound	ng/m³
		CO_2	
		cyclopropane	
1	45	dichlorodifluoromethane	
2	46	chloromethane	
2A	47	propane	
3	51	i-butane	
4	53	n-butane	
5	53	SO_2	
6	56	chloroethane	
7	59	acetaldehyde	
9	61	isopentane	
10	62	trichlorofluoromethane	
10A	63	C_5H_{10} isomer	
11	64	C_5H_{10} isomer + furan	
12	65	n-pentane	
13	67	propanol	
13A	68	dichloromethane	
15	70	acetone	
16	78	1,1-dichloroethene	
16A	79	2-methylpentane	
16B	80	3-methylpentane	
17	83	C_6H_{14} isomer	
18	84	C_6H_{12} isomer	
19	85	hexafluorobenzene (c8)	
19A	89	2-methylfuran	
20	86	n-hexane	
21	87	chloroform	
21A	88.5	methyl ethyl ketone	
23	92	perfluorotoluene (c8)	
24	93	methylcyclopentane	
25	94	1,2-dichloroethane	10,016
25A	96	1,1,1-trichloroethane	
26B	97	C_7H_{14} isomer	
27	98	C_6H_{10} isomer	
28	100	benzene	16,210
29	101	carbon tetrachloride	
29A	101	cyclohexane	
30	102	2-methylhexane	
31	103	2,3-dimethylpentane	
32	104	3-methylhexane	
33	107	dimethylcyclopentane isomer	
34	108	dimethylcyclopentane isomer	
35	109	trichloroethylene	9,210
36	110	n-heptane	
38	113	2,5-dimethylfuran	
39	116	trimethylpentane isomer	
41	117	methylcyclohexane	
41A	117	C_8H_{16} isomer	
42	118	C_8H_{18} isomer	
43	119	4-methyl-2-pentanone	
44	121	C_8H_{16} isomer	
45	123	C_8H_{16} isomer	
46	124	1,1,2-trichloroethane	17,100
47	125	toluene + C_8H_{16} isomer	
48	126	3-methylheptane	
49	131	dimethylcyclohexane isomer	
50	132	2-hexanone	
51	133	C_8H_{16} isomer	
52	135	n-octane	
53	136	n-butyl acetate	1,611
54	137	tetrachloroethylene	10,000
55	139	C_8H_{16} isomer	
56	140	C_9H_{20} isomer	
57	141	C_9H_{20} isomer	
57A	142	C_8H_{16} isomer	
58	143	C_9H_{20} isomer	
59	144	methyl ethyl cyclopentane isomer	
59A	144	chlorobenzene	
60	145	trimethylcyclohexane isomer	
60A	146	n-nonane	
61	148	ethylbenzene	
61A	149	C_9H_{20} isomer	
62	151	p-xylene	
63	152	C_9H_{20} isomer	
64	153	2-heptanone	
64A	154	2-butylfuran + C_9H_{18} isomer	
65	155	styrene	
65A	155	C_9H_{18} isomer	
66	156	o-xylene	
66A	157	C_9H_{18} isomer	
67	158	n-nonane	
68	159	$C_{10}H_{20}$ isomer	
68A	161	methylethylcyclohexane isomer	
69	161	$C_{10}H_{22}$ isomer	
69	162	isopropylbenzene	
67	163	$C_{10}H_{20}$ isomer	
69	164	2,3-dimethylstyrene	
69	165	3-methylnonane	
70	166	n-propylcyclohexane + $C_{10}H_{16}$ isomer	

(continued)

Table 36 (cont'd)

Chromatographic Fraction Peak No.	Elution Temp (°C)	Compound	ng/g[1]
71	187	octanoic isomer + $C_{10}H_{22}$ isomer	
72	188	$C_{10}H_{20}$ isomer	
73	189	benzaldehyde + p-propylbenzene	
73A	190	$C_{10}H_{22}$ isomer	
74	191	p-ethyltoluene	
75	192	$C_{10}H_{22}$ isomer	
76	193	1,3,5-trimethylbenzene	
77	193	$C_{10}H_{22}$ isomer	
77A	193	cyanobenzene	
78	194	6-methyl-2-heptanone (tent.)	
79	195	p-ethyltoluene	
80	196	$C_{10}H_{18}$ isomer	
81	196	$C_{10}H_{20}$ isomer	
82	197	[illegible]	
83	199	p-[illegible]	
83A	199	[illegible]	
84	200	$C_{10}H_{20}$ isomer	
84A	200	isobutylbenzene	
85	201	p-dichlorobenzene	
85A	201	sec-butylbenzene	
86	202	$C_{11}H_{24}$ isomer	
86A	202	C_3-alkyl benzene isomer	
87	203	$C_{11}H_{24}$ isomer	
88	204	n-butylbenzene + 1,2,3-trimethylbenzene	
89	205	$C_{11}H_{24}$ isomer	
89A	205	$C_{11}H_{22}$ isomer	
90	206	$C_{11}H_{24}$ + p-dichlorobenzene	
91	207	indan	
91A	208	p-butylcyclohexene + $C_{11}H_{22}$ isomer	
92	209	diethylbenzene isomer	
92A	209	p-propyltoluene	
93	210	p-propyltoluene + p-butylbenzene	
94	211	acetophenone	
95	211	$C_{11}H_{24}$ isomer	
95A	212	$C_{11}H_{22}$ isomer	
96	213	p-propyltoluene + $C_{11}H_{24}$ isomer	
97	215	C_3-alkyl benzene + $C_{10}H_{18}$ isomer	
98	216	C_3-alkyl benzene + $C_{11}H_{22}$ isomer	
98A	216	$C_{11}H_{20}$ isomer	

Chromatographic Fraction Peak No.	Elution Temp (°C)	Compound	ng/g[1]
99	217	$C_{11}H_{22}$ + methylindan isomer	
100	218	n-undecane	
101	220	C_3-alkyl benzene + $C_{11}H_{14}$ isomer	
101A	220	C_3-alkyl benzene + $C_{10}H_{14}$ isomer	
102	221	$C_{11}H_{24}$ isomer	
103	222	$C_{10}H_{20}$ isomer	
104	223	tetramethylbenzene isomer	
105	223	$C_{10}H_{20}$ isomer	
105A	224	$C_{11}H_{20}$ isomer	
106	225	C_3-alkyl benzene isomer	
107	226	C_3-alkyl benzene isomer	
	226	C_3-alkyl cyclohexane isomer	
	227	[illegible]	
108A	228	C_3-alkyl benzene isomer	
109	228	$C_{10}H_{14}$ isomer	
110	229	$C_{11}H_{22}$ isomer	
111	230	C_3-alkyl benzene isomer	
111A	230	C_3-alkyl benzene + $C_{10}H_{16}$ isomer	
111B	231	C_3-alkyl benzene isomer	
112	231	C_3-alkyl benzene + $C_{10}H_{16}$ isomer	
112A	232	$C_{10}H_{14}$ + $C_{10}H_{22}$ isomers	
113	233	C_3-alkyl benzene isomer	
113A	233	$C_{10}H_{16}$ isomer	
114	234	$C_{10}H_{22}$ isomer	
115	235	trichlorobenzene + $C_{10}H_{14}$ isomer	1,700
116	236	n-dodecane + naphthalene	
116A	237	$C_{10}H_{14}$ + trimethylindan isomers	
117	238	$C_{10}H_{22}$ + $C_{11}H_{16}$ isomers	
118	239	$C_{11}H_{24}$ isomer	
119	239	$C_{11}H_{16}$ isomer	
120	240	$C_{11}H_{24}$ isomer	
120A	240	C_3-alkyl cyclohexane isomer	
121	241	$C_{11}H_{16}$ isomer	
122	242	$C_{11}H_{16}$ isomer	
123	243	$C_{11}H_{22}$ isomer	
124	244	methyltridecane isomer	
125	245	$C_{11}H_{16}$ isomer	
126	246	$C_{11}H_{24}$ isomer	
127	247	n-tridecane	
128	248	$C_{11}H_{22}$ isomer	
129	249	2-methylnaphthalene	

(continued)

Table 36 (cont'd)

Chromatogram Position Peak No.	Type	Compound	ng/m³	Chromatogram Position Peak No.	Type	Compound	ng/m³
131		$C_{15}H_{26}$ isomer					
131A		$C_{15}H_{24}$ isomer					
132		1-methylnaphthalene					
133	Isothermal	$C_{15}H_{28}$ isomer					
135		C_{15}-alkyl cyclohexane isomer					
136		$C_{16}H_{30}$ isomer					
137		$C_{15}H_{32}$ isomer					
138		n-tetradecane					
140		$C_{16}H_{30}$ isomer					
142		dimethylnaphthalene isomer					
143		dimethylnaphthalene isomer					
144		$C_{15}H_{24}$ isomer					
145		n-pentadecane					

[a] Ambient air sampled at 2055 223 St., Dominguez, CA (Fig. 11) see Table 17 for treatment.